ELECTRICAL REVIEW

ILLUSTRATED.

A WEEKLY JOURNAL OF

Electric Light, Power, Telephone, Telegraph and Scientific Progress.

VOL. 18, No. 8. WEEKLY.

NEW YORK, SATURDAY, APRIL 18, 1891.

$3 per annum. Single Copies, 10 Cents.

Copyright, 1891, by Electrical Review Publishing Company, 13 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

Epoch-Making Inventions of America.

BY JUDGE ROBERT S. TAYLOR, OF FORT WAYNE, IND., BEFORE THE INVENTORS' CONGRESS.

The following is an outline of the able and interesting discourse delivered by Judge Taylor:

The real and enduring wealth of the world is its thoughts. It is the capacity to originate, communicate and preserve thoughts that makes civilization possible. We deal to-day with the thoughts of the inventor, and I, particularly, with those productions of his thought which enter into human life and history with such effect that they can be called epoch-making inventions.

It wants just a year of a century since there flashed across the mind of a young Georgia school teacher the thought that a machine could be made which would separate the cotton fibre from its seed by the action of saw teeth. With that thought dawned the epoch of cheap cotton cloth. Forty-six years later, the sewing machine made its appearance to sew the cloth and inaugurate the epoch of cheap clothes. The two together gave the human body a new skin.

Robert Fulton once said that the three men who had conferred most good on their fellows were Arkwright, Watt and Whitney. He was the fourth. He opened the epoch of steam travel. The railroad and locomotive followed, like the evolution of birds from fishes, and the Chicago Limited is the legitimate descendant from a paddle wheel steamboat.

Since Franklin drew the first submissive spark from heaven, Americans have been foremost in the great field of electricity. The subjugation of this great force was begun when Professor Morse taught it to talk. The steam engine is the breath and muscles, the telegraph the nervous system of the body politic.

In the production of electric light, man has come nearer to creation than anywhere else. He has produced upon the earth the light of the heavens—a true sunlight in fragments. But the most gratifying of all inventions is the telephone. It imparts a new function to speech and a new sense to the ear. It introduces the epoch of neighborship without propinquity, and lengthens life by saving time.

The epoch of news came in with Hoe's cylinder press, of a new dimension for cities with the vertical railway, and of cheap food with McCormick's reaper.

There is no more beautiful invention than the typewriter, the sewing machine of thought, which clothes our idea, as that clothes our bodies.

The patent system of the United States rests on 22 words in the Constitution. What other 22 words ever spoken or penned have borne such fruit of blessing to mankind?

Pueblo is Well Lighted.

The Pueblo, Colo., Gas and Electric Light Company was organized as a gas company 10 years ago, and when electric lights came into fashion an electric light plant was added to its gas works. The capital stock of the company is $300,000, fully paid. The company is running 1,400 sixteen candle-power incandescent lights on the Heisler system and two hundred and ninety-nine 2,000 candle-power Thomson-Houston arc lights. They have lately made $5,000 improvements at the works.

The Pueblo Light, Heat and Power Company is a new institution and furnishes electric lights only. It includes 2,000 incandescent lights and 47 arcs, using the Westinghouse system. The capital stock is $100,000, $75,000 being paid in. Arrangements are being made to double the capacity of its plant at an expense of $25,000.

A New Form of Megohm Resistance.

BY RICHARD W. DAVIDS, READ AT THE MEETING OF THE ELECTRICAL SECTION, FRANKLIN INSTITUTE, HELD MARCH 10, 1891.

The instrument of which this paper treats is not new entirely, but has been used for some years in England to a limited extent, so that the title refers mainly to its introduction in this country.

It is designed to take the place, at a small cost, of expensive and cumbersome wire resistances having approximately equal values, or the use of varying shunts, different electro-motive forces and the wire resistances in ordinary use in measuring commercially the insulation resistance of cables, air lines, etc., by means of proportional deflections on a sensitive galvanometer. The resistance of these boxes varies from one to five megohms, although these limits are not necessary, so that they may be had approximating the resistances which are met in every-day use.

FIG. 1.—POLICE AND SIGNAL SYSTEM, MUNICIPAL COMPANY, BOSTON.—STATION HOUSE DESK, SHOWING REGISTER, TIME-STAMP, ETC.

So far as it is known to the writer the construction is as follows: On an etched glass plate of some 4x6 inches a pencil line is drawn resembling a sinusoid, experience teaching, to a small degree, however, its breadth and length; the pencil used is probably an ordinary lead or, rather, graphite pencil, of a hardness found empirically to give the best results; this line is burnt into the plate, most likely with the use of a flux; this operation has to be done slowly and takes some time. After a rough test for resistance to find if it is within the range sought, it is mounted in a block on springs to take up jars and make connection with the ordinary tall binding posts of apparatus needing high insulation.

There is no attempt made at adjusting these boxes, the plates are made and measured, any that are too high or too low being rejected, the surfaces ground off and made over again. In this way a comparatively cheap instrument is obtained. They are not laboratory instruments, but designed to meet the want of every-day line and cable testing, where speed and not great accuracy is desirable.

A somewhat similar instrument for laboratory work consists of a plate of unglazed porcelain, or even a sheet of paper, having pencil marks made on it, connection being made by means of springs resting on these marks. The objection found in these forms is that a breath of wind or jar may so change the contacts of the graphite particles as to seriously alter the resistance.

Some 20 of these boxes were brought the writer for calibration, and the question arose as to the best way to measure them accurately and quickly. The first method tried was with a Thomson reflecting galvanometer, finding its constant with the one-ninety-ninth shunt, and sufficient resistance to give nearly the same deflection as with the meg and no shunt, using in both cases 40 cells of chloride of silver battery.

As checks, other measurements were made using no shunts and varying the electromotive force; and also the bridge method. It is fortunate there were two boxes of 100,000 ohms each at hand, as the second and third terms of the proportion, and with these calibrated in terms of a standard box which was the first term, it was possible to determine accurately the meg, the fourth term.

It was disappointing to find the checks did not check, those figures obtained with the shunt method being much out. As the shunts were found to be practically correct, it could not be due to them, and on repeating the measurement with accumulators the discrepancy disappeared, showing that the silver battery, even with small currents, polarizes. Everything seemed to go nicely now, having perfect faith in the bridge method, when, in order to get a closer balance, the battery was increased considerably, with the disheartening result that it appeared the resistance depended on the current used. This change was very small, less than one per cent., and negligible in practice, but it seems to show that with such small currents as through of an ampere, appreciable change takes place, perhaps from heat, directly or indirectly.

As an interesting point, the heat developed in such a box would raise one sixteenth of a grain of water one degree C. in one minute. Supposing the resistance to be due to the imperfect contact of two adjacent molecules of carbon, the rise in temperature given could scarcely be enough to change the resistance.

It has been stated that change of temperature from 0 to 40 degrees C. makes a difference of less than one per cent. in the value. Also, that boxes made some years ago are practically the same now.

The use of the instrument was shown in one of the checks used. This was to find the comparative resistances of the various boxes by direct deflections varying nothing but these with the megohms. With a very portable and accurate d'Arsonval galvanometer, the other boxes were checked rapidly; this was in effect measuring them, taking it for granted any one was right.

In measurements on the street or in other places where it is difficult to set up and use an ordinary reflecting galvanometer, resistance boxes, different batteries, etc., all that would be necessary to get a very close measurement would be such a galvanometer, suitable battery and such a megohm resistance.

Failure to Deliver Telegram.

A distilling company sent a message to boiler-makers in a neighboring city notifying them that a boiler was out of repair and asking them to "send a man at once," says *Bradstreet's*. By reason of the failure of the telegraph company to transmit or deliver the message, the distilling company was compelled to suspend operations for 24 hours longer than it would have done had the message been transmitted and delivered in the regular course of business. The Superior Court, of Kentucky, held, in an action against the telegraph company, that the sender of the message was entitled to recover for the additional expense incurred in feeding cattle and the additional amount paid to hands by reason of the delay caused by defendant's failure to transmit the message. The court said that as it was the business of the firm to which the message was sent to send men to repair boilers, it must be presumed that they would have pursued their usual course of business, and it was not reasonable to presume that had the man been sent he could not have done the work. (Rich Grain Distillery Company *vs.* Western Union Telegraph Company.)

An Electric Awakener.

The alert electrical inventor is constantly bringing out new things to assist in making life convenient, agreeable and accurate. One of the latest novelties now being shown by Messrs. Alexander, Barney & Chapin, of this city, consists of the usual alarm clock with an electric attachment, which includes in circuit one of the rollers at the bottom of the legs of the bed. When the hour arrives at which the sleeper has set the alarm, his weight closes the circuit and the bell rings and continues to ring until the sleeper gets off the bed. A spring is adjustable to the weight of the person.

THE PROPHET'S COLUMN.

The traditional catskin; the experiments with bits of amber and the silk handkerchief, and the explanation about vitreous electricity and resinous electricity, which for so many years have done faithful duty in the opening chapters of text books on electricity, have now no further reason to be.

The early experiments of Faraday, the marvelous mathematical researches of Maxwell and the crowning experiments of Hertz, all showing the intimate relations which exist between electricity and light, have so entirely changed our views of science, that it has been truly said that electricity has annexed the whole domain of optics. The electrical text books of the future will begin with the ether.

Faraday gave us an experiment which shows that an electric current, circulating through a coil of wire, can actually bend or twist a ray of polarized light. Dr. Kerr in 1875 produced an experiment which showed that when glass is subjected to an intense electric strain it acquires new properties and produces a twisting effect upon a ray of light which is not present when the strain is removed. The same investigator also showed that when an ordinary ray of light was reflected from the highly polished pole of a powerful magnet, it was found to have been twisted or bent in a peculiar manner, and our own Dolbear has produced the converse of this experiment, and magnetized a cambric needle by placing it, for ten minutes, in the focus of a beam of circularly polarized light which passed it longitudinally.

The genius of Maxwell has said one medium for electricity and light, and has given us the electro-magnetic theory of light. The wonderful work of Hertz, happily not yet ended, has placed within our grasp a method of experimentation whereby electrical waves have been generated and found to obey much the same laws as those of light. All of the familiar experiments of reflection, refraction and interference have been performed with electric waves passed through suitable lenses. The far-reaching effect of all these discoveries will not be appreciated until all of those now living are dead.

It would be idle to predict a boom in sign painting, because opticians may be proved to be electricians, but it is in the field of the optical instrument maker that one of the most glorious possibilities of electricity is to be found. What is a telescope? Nothing but a combination of lenses or mirrors, the primary function of which is to bend or reflect a ray of light. But has it not been shown that an electric field will bend a ray of light, and that a ray of light reflected from the polished pole of a magnet is peculiarly twisted?

The part which electricity has hitherto played in astronomical science has been limited to a few technical applications principally associated with signaling and the making of chronographic records, but it is the destiny of this infant giant to work greater changes in the study of the heavens than has ever been dreamed of by man.

Why is it so difficult and expensive to construct an immense telescope? From the time of Galileo to that of Clark, steady work has been done, and each step has given us a larger object glass. The pupil of the eye is one-fifth of an inch in diameter, and can grasp but a limited amount of light, A 25-inch object glass will enable the eye to take in over 15,000 times more light, and with such a glass the moon can be seen as though it were only 80 miles away, but if the size of the object glass could be further increased the moon would be brought considerably nearer. To make a large object glass is the difficulty, and it is only after years of patient work of the most skilled men on earth and after repeated attempts, that one can be produced which is accurate. Slight differences of specific gravity; changes of structure due to jarring; strains resulting from unequal pressure and changes of temperature, are all capable of ruining the work.

But why not replace the glass, which is only a medium transmitting light at a different velocity from air, by a properly constructed electric field? It is conceivable that an electric field 50 feet in diameter could be arranged. Just what the nature of this field should be, with our present knowledge, we cannot say; but some day it will be known and then the secrets of other planets will be ours.

Speculation about the planets is as old as man. From the days of the early Arab shepherds, our first astronomers, who, while tending their flocks on the hills, gazed at the starry heavens with the eye of nature, to these days of marvelous optical instruments, it has been a favorite theme for dreamy minds. Their movements, size and brilliancy were in turn studied. The possibility of their being other worlds like ours and inhabited by beings like ourselves has afforded food for infinite thought, and philosophic minds have evolved theories about the transmigration of souls from one planet to another.

It was but natural that some advanced mind should conceive of the possibility of attracting the attention and establishing communication with the supposititious inhabitants on some of the planets. This idea has been presented by various writers in different ages. It made its last appearance in a *Forum* article by Jules Verne, where a newspaper magnate of the future is found discussing with his telegraph editor a revolution which is going on in the "Central Empire of Mars." By most men such questions are considered entirely too visionary even to think of; but they must not be confounded with that kind of a proposition in which a man sought to transfer himself to the opposite side of a fence by lifting on his bootstraps. On the contrary, they are perfectly in accordance with the laws of the conservation of energy and form a most entertaining subject for scientific analysis.

Of all the heavenly bodies, Mars most resembles the earth. On its surface can be seen land and water forming a system of continents and oceans with snow at both poles, all strangely resembling the earth. Clouds and mists have been watched at various times, and in the Summer the ice and snow appear to melt. It is most natural to ask if Mars is inhabited. If it is, what is the nature of the people living there? Do they represent a higher or a lower type than man, as found on earth? What if the inhabitants of Mars are so much farther advanced than us that they possess telescopes of a power beyond all comparison with ours, and have been gazing at us for centuries, and have even, perhaps, been vainly trying to attract our attention and set up communication with the earth?

One of the most curious features noticed in observing Mars is the strange markings which seem to extend across the planet's disk in such a regular manner as to bring up a suggestion of their artificial nature, and give to them the name of the Canals of Mars. The probability of these canals being the work of beings, like man, has been disputed, on account of their immense size, some of them being 1,000 miles long and 30 miles broad. But, even assuming that the inhabitants of Mars have the same physical constitution as man, it is still possible that they could do this work, because it should be remembered that on Mars the force of gravity is very much less than on earth, and that on the surface of Mars a man of ordinary stature could disport himself with extraordinary agility, and perform in a day an amount of physical labor vastly in excess of that which he could do on earth.

FIG. 2.—SIGNAL BOX.—IN POSITION TO BE OPERATED WITH "CITIZEN'S" KEY.

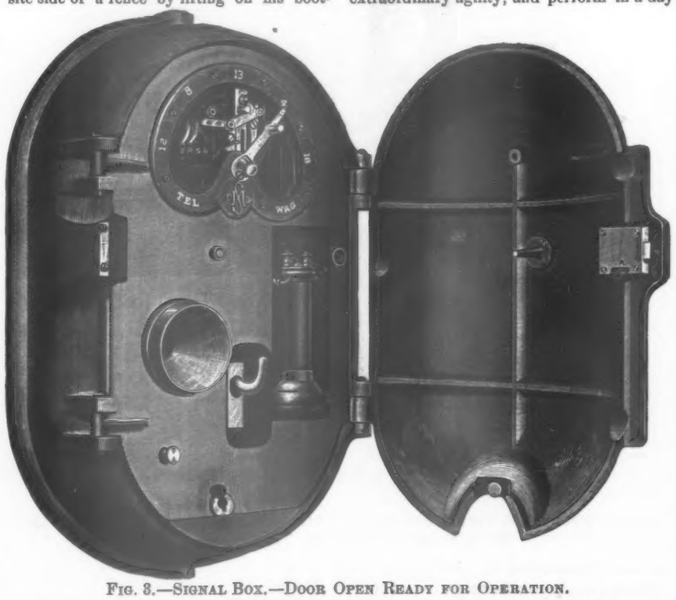


FIG. 3.—SIGNAL BOX.—DOOR OPEN READY FOR OPERATION.

Recent observations by Schiaparelli show that these canals are undergoing changes of a remarkable nature. What if these great streaks were the efforts of the inhabitants of Mars to signal to us! Perhaps they are the letters of an alphabet of a race superior to ours, which is trying to attract our attention by means of some great interstellar semaphore. If we had a wire reaching from the earth to Mars, discussions of the possibility of establishing communication over it would not only be tolerated but encouraged.

But have we not a conducting medium from the earth to Mars, and is it not a medium through which it is possible to transmit signals and even speech? THE PROPHET.

The Municipal Signal Company's Police and Fire Alarm Systems.

The cuts presented herewith show several pieces of apparatus of the police and fire alarm systems operated by the Municipal Signal Company, 79 Franklin street, Boston. In this system numbered signal boxes, containing telephones and automatic signaling instruments, are placed on every patrolman's beat, and are electrically connected with the police station. From them the patrolman can either telephone or automatically transmit messages to the station, or the station house can signal the patrolman. Citizens can also summon police assistance from any signal box.

The signaling system consists of three distinct and non-interfering methods of communications; viz., automatic and manual signaling from the street stations to the station house, automatic and manual signaling from the station house to the street stations, and telephonic communication between the street stations and the station house and *vice versa*. These are arranged to operate over a single metallic circuit, to produce certain results and reach the desired ends. The signaling from the street stations to the station house is further divided into two classes; alarm signals, comprising signals directing the station house to send a patrol wagon or ambulance, or to use the telephone; and "patrol" or "on duty" signals, which indicate at the station house the movement of the patrolmen over the territory under their charge.

The signaling from the station house to the street station is accomplished by the use of currents of electricity of a different character from those employed to signal from the street station to the station house, and they sound a bell in the street station to indicate the reception by the station house of an alarm signal, or to announce to the patrolman that the station house desires to speak to him by telephone. The telephones are inductively connected with the circuit, and they are so arranged, with relation to the signaling part of the system, that conversation may be carried on between two or more points, signals may be sent from a street station to the station house, and from the latter to the former, all simultaneously over a single wire without interference or confusion.

In Fig. 2 a signal box is shown in position to be operated with a citizen's key. Fig. 3 shows a signal box with the door open. The stable apparatus for patrol wagon service is shown in Fig. 4, while the station house desk, showing register, electric time-stamp, etc., is illustrated in Fig. 1.

When the door of the signal box is open (Fig. 3), a large dial and pointer, the automatic signal pull co-operating therewith, a telephonic receiver and transmitter, are exposed to view. Upon the dial are inscribed the alarm signals as desired. Upon the inside of the dial is mounted the signaling mechanism, including a gong to receive and sound the signal sent from the station house. By turning the pointer to the service required and operating it by the pull, any one of the inscribed signals may be automatically transmitted. A push button is also provided to communicate with the station when a connecting wire is broken. A call for the patrol wagon may be sent from the outside with the door closed, by simply inserting a key, termed the "citizen's key," into a keyhole at the front of the box, turning it as far as it will go. This key cannot be withdrawn until the door is opened, A master key is carried by each patrolman.

The boxes are made of iron, very strong and substantial. The multiple signal transmitter is very simple and positive and is not liable to become deranged. The pointer may be turned to the right or left, and the act of closing the box door always sets it back to the zero or starting point. The wiring of the boxes and every detail of their construction is executed in the most careful way.

The receiving cabinet to be used in the station house is shown in Fig. 1. It is carefully constructed and wired, and serves as a very convenient operating table. The signals received from the street stations are recorded in ink upon a paper tape, which also receives the impression of an automatic time and date stamp, so as to mark upon the tape the exact time at which each signal is received.

This system is in use in Boston and Somerville, Mass., and several other important cities and towns. It has been very highly commended by those who have had it in their charge.

JOTTINGS FROM THE FOREIGN TECHNICAL PRESS.

Mr. Otto Weiner contributes to the January number of the *Journal de Physique* an account of some remarkable experimental work carried out with the object of determining the direction of the vibrations in a beam of polarized light. Mr. Weiner applied the methods used by Hertz in getting stationary electro-magnetic waves by reflection at a metallic surface, and experimented with a beam of polarized light reflected from the surface of a plane mirror. An extraordinarily delicate method of test was employed. If the light is reflected normally by the mirror, the nodes and internodes occur in planes parallel with the reflecting surface, but by inclining a thin photographic film at a very small angle with the mirror, it was found possible, in spite of the minuteness of the wave length, to sufficiently separate the parts of the film where interference took place to obtain photographic bands corresponding with them. The study of these bands shows several interesting things. It shows that in the act of reflection a reversal of phase occurs, and also that the chemically active vibrations are always perpendicular to the plane of polarization. The latter point is important, and was established by studying the effect of reflecting polarized light at an angle of about 45 degrees with the mirror. When the plane of polarization coincided with the plane of incidence, well defined bands were obtained; but when the planes were perpendicular to each other, none could be detected. The experiments form, says the *Electrician*, an interesting instance of the reaction, an optical theory, of recent researches on electrical oscillations, and they prove that there is a distinct optical difference between the two kinds of vibration which occur in an electro-magnetic wave. The magnetic vibrations have no influence on a photographic film, while the electric vibrations are chemically active.

The *Electrician*, in its leading editorial of the 27th ult., falls foul of Postmaster-General Wanamaker's recently published annual report, or rather of that portion of it devoted to the half-hearted postal telegraph scheme which is one of Mr. Wanamaker's pet hobbies. Our contemporary seems to think that the "bill to establish a limited post and telegraph service" is far too limited and restricted in what it proposes to do in the way of affording more extended and cheaper telegraph service in this country. Says the *Electrician:* "Its (America's) enormous area, the unequal distribution of its vast populations, and the varied character of their industrial pursuits, all combine to make it next to impossible for any private corporation to extend the advantages of telegraphy everywhere and to all alike. But all the greater reason for the State to step in, as it has done in Europe, and supply what is needed at the State's expense." If it be true that the telegraph is of like importance to the welfare and well-being of the people as the post office—and the postal telegraph scheme is propounded on this assumption—surely it follows that the duty of providing it on the same terms is not less pressing and not less beneficial in its probable results. Whatever comes of the "modest" experiment now under discussion, a more ambitious and bolder one will have to be essayed by the United States government sooner or later—and the sooner the better, we should imagine.

In New York electrical affairs suffer from too much State and municipal interference and it seems that in London just now electrical men are chafing under similar grievances. The electric light companies are quarreling with the Board of Trade regarding the stipulated insulation of overhead wires, and the London public generally is quarreling with the Postmaster-General for his interference with the messenger companies recently established on the American plan. It has frequently been argued that messenger and cab-hire being so cheap in London there was no demand for a regular service of electric calls, such as we are accustomed to in American cities, but the call-boxes once having been put in and the messengers at hand, the immense conveniences of the service were very quickly appreciated and the Postmaster-General's action aroused a storm of indignation from all quarters. Mr. Raikes, it is true, stood on his legal rights as head of the department having the sole right, according to law, of carrying letters. It appears now that the matter has been arranged and that the companies will be allowed to carry on their business paying a royalty to the Post Office. The only wonder is that such a service was not established in London many years ago.

The dispute between the electric lighting companies and the Board of Trade is quite a different matter. The Board specifies that overhead electric light wires shall be insulated to a certain thickness, the thickness of the dielectric being in ratio to the electromotive force employed. The electric light companies have discovered that to comply with the rules of the Board in this respect they would have to use such an enormously expensive wire as to be practically prohibitive from a commercial point of view. They have shown by numerous tests of different kinds of cable, some of the tests having been made by the technical adviser of the Board himself, that a wire having a much lesser thickness of dielectric than that demanded will give an ample margin of safety. The class of wire they propose to use gives an insulation resistance of 5,000 megohms per mile at 60 degrees Fahrenheit, and will withstand perfectly a pressure of over 2,000 volts. A large amount of correspondence has been exchanged between the companies and the Board, and it is perfectly clear that the position of the latter, or rather, of its technical adviser, is totally unwarranted, but there seems to be no sign of an agreement being reached and an unfortunate dead-lock is the result. What would electric light companies in this country say if they were told that wire having an insulation of 5,000 megohms per mile, tested under water at 60 degrees, was not good enough for overhead work?

FIG. 4.—STABLE APPARATUS, FOR PATROL WAGON SERVICE.

The *Electrical Engineer* points out that the transformer was invented long before the time of Gaulard and Gibbs. When the first Atlantic cable was being constructed, the promoters expected to require an electric pressure difficult to obtain with batteries, so the energetic spirits set to work to devise means to "transform upwards." The result was a closed circuit transformer, designed by Dr. Whitehouse in 1856 or 1857. One of these early transformers is now in the possession of Mr. C. E. Phillips, of London. Similar apparatus was employed by the Messrs. Siemens for some of the early Mediterranean cables. "It would be interesting," says our esteemed London contemporary, "to get the complete history of these 'transformers,' to know exactly how they were constructed and how it was proposed to use them." We can scarcely see how our esteemed contemporary can connect the use of induction coils with the invention of the alternate current transformer. Induction coils were certainly used for increasing the tension of the current for signaling through some of the early submarine cables, but they were only looked upon as induction coils pure and simple, and not as transformers. Would the *Electrical Engineer* have us believe that the first Atlantic cable was worked by means of rapidly alternating currents?

New Storage Battery Work—The Electrical Accumulator Company.

The storage battery cars equipped by the Accumulator Company, and installed according to the "Edco" system, invented by Mr. W. W. Griscom, have been in successful operation upon the tracks of the Dubuque Street Railway Company, in Dubuque, Iowa, and of the Eckington and Soldiers' Home Railway Company, in Washington, D. C., and this fact has, we are informed, given such an impetus to the street car business of the Accumulator Company and the Electro Dynamic Company, of Philadelphia (the latter company making the motors, gearing, switches and other apparatus, except accumulators, embraced in the Edco system), as to make it necessary to consolidate in Philadelphia the general offices of the two companies named, so that the officers and heads of departments of both companies shall be in constant communication with each other. New and commodious offices have been secured, fronting on Chestnut street, Philadelphia (Nos. 224 and 226), and extending back to Carter street, upon which the six story factory of the Electro Dynamic Company is located. These offices will be fitted up so as to accommodate the executive officers, the superintendent and the technical departments of both companies, at the same time enabling the factory facilities to be increased to the extent now covered by the Electro Dynamic Company's offices.

The Eckington and Soldiers' Home Railway Company, in addition to its contract for a full equipment of Edco storage battery cars for its G street and Fifth street branches, has recently ordered from the Electro Dynamic Company two 40 horse-power Edco slow speed dynamos with self-oiling bronze bearings, and tempered copper commutators, work on which is being pushed forward as rapidly as possible. The factory of the company is being worked to its full capacity, including three nights' service a week.

Mr. D. H. Bates, vice-president and general manager of the two companies, has resigned these positions, to date from May 1, in order to take a general selling agency for street car equipments upon the Edco system, with headquarters in New York, in the same offices which the two companies named have occupied for the past five years.

The electrical fraternity and the street railway officials and public have now an opportunity of satisfying themselves that the storage battery system of street car propulsion is economical, in view of the fact that the system is in practical every-day operation in Dubuque and Washington on the roads above named, and to the great satisfaction of the owners.

Messrs. Truex & Vail, also located at 44 Broadway, New York city, are the general selling agents for New York and New Jersey for accumulators and Edco apparatus for other than street car work.

Electrocution News.

Nicola Trezza, the young Italian, who is under sentence of death for the murder of his countryman, Alessandro Salvano, at Flatbush, one year ago, last Easter Sunday, was in the Supreme Court, Brooklyn, last week, on a writ of *habeas corpus* secured by his counsel, ex-Judge Abraham H. Dailey. Trezza has been twice sentenced, the last time to be executed at Sing Sing during the week beginning on April 20. Justice Cullen intimated that he had made a very careful examination of the law on the case since he granted the writ of *habeas corpus*. In his opinion the writ must be dismissed and the prisoner remanded to await the execution of his sentence.

The second appeal of Shibuya Jugiro to the United States Supreme Court from the sentence by which he was condemned in New York State to electrocution, came up at Washington, April 10. The court heretofore refused to grant a writ of *habeas corpus*, based on the contention that electricity was a cruel and unusual mode of punishment, and the present application is made on the ground that there were errors committed at the trial.

Argument was also had in the Supreme Court on the application for a writ of *habeas corpus* for Joseph Wood, the negro who is under sentence of electrocution, the principal point being the absence of negroes on the jury.

Portland, Me.—The Waters Electric Company; capital, $250,000.

Jersey City, N. J.—Telegraphic Novelty Company; capital, $45,000.

Harrisburg, Pa.—The Electric Signal Clock Company; capital, $50,000.

Rome, N. Y.—The Gansevoort Electric Light Company; capital, $10,000.

Detroit, Mich.—Edison Illuminating Company; capital increased to $100,000.

Cincinnati, O.—The Newport Electric Street Railway Company; capital, $100,000.

Neihart, Mont.—The Neihart Electric Light and Power Company; capital, $20,000.

Boston, Mass.—Mechanical, Electrical, Scientific and Railway News Bureau; capital, $1,000.

Detroit, Mich.—Detroit Electrical Works; increase of capital from $500,000 to $2,000,000.

McPherson, Kan.—The Western Water and Electric Light Company; capital stock, $25,000.

Great Falls, Mont.—The Belt Creek Water and Electric Light and Power Company; capital, $25,000.

Greenville, S. C.—Greenville Gas, Electric Light and Power Company; capital, $55,000. Col. James L. Orr, president.

Jersey City, N. J.—Woodbridge & Turner Engineering Company, to construct and operate electric railroads; capital, $200,000.

Chicago, Ill.—The Morgan-Gardner Electric Company, to manufacture electric mining machinery and other electrical devices; capital, $100,000.

Chicago, Ill.—Union Electric Works, to manufacture and deal in all kinds of electrical devices and appliances; capital stock, $50,000. Incorporators: F. C. Rutan, Ernest W. Cooke and William W. Anderson.

Chicago, Ill.—Dawn Electric Company, to do an electrical construction business, and to control, operate and sell electric light and power apparatus; capital stock, $20,000. Incorporators, Henry P. Williams, J. A. McEnter, J. M. Glenn.

Poles in Cincinnati.

The decision of the Circuit Court at Cincinnati, prepared by Judge Smith, in the appeal cases of the Brush Electric Light Company *vs.* the Jones Bros. Electric Company, and the same plaintiff *vs.* the Queen City Electric Company, has been handed down. The cases were fiercely fought in the court below, and their final determination is a matter of much interest to all users of electricity conveyed to them by wires, as well as to all electric companies, and particularly those parties to the action.

The Brush Company obtained a grant from the city council in 1882 for the erection of poles for electric wires in the streets and alleys of the city. Other companies have since obtained similar grants from the Probate Court, but the Brush Company has stubbornly refused to recognize the validity of the Probate franchises, and has claimed the exclusive use of the poles which it has erected under its own franchise from council. In carrying out this claim of the exclusive use of such poles, the suits just decided were brought to enjoin the defendant companies from attempting to string any wires upon them. The decision of the court is against this claim, and leaves all electric companies in Cincinnati standing, for the present, at least, on the same footing.

ELECTRICAL REVIEW

Published at 13 Park Row,
P. O. Box 3329. NEW YORK.

EDITORS:
GEO. WORTHINGTON. CHAS. W. PRICE.
ASSOCIATE EDITORS:
ROBT. H. READ. STEPHEN L. COLES.

BUSINESS STAFF:
GEO. WORTHINGTON, President. CHAS. W. PRICE, Secretary.
ROBT. H. READ, Manager Patent Bureau.
H. T. RICHARDS. Mgr. Advertising Department.

REGISTERED CABLE ADDRESS:
"ELECTVIEW," NEW YORK.
"1546 CORTLANDT." TELEPHONE CALL.

BOSTON OFFICE:
W. I. BARKER, Room 29, 620 Atlantic Ave.
WASHINGTON OFFICE:
GEO. C. MAYNARD, 1409 New York Ave.
CHICAGO OFFICE:
L. W. COLLINS, 435 "The Rookery."
EUROPEAN OFFICE:
CHARLES FFRENCH, Editor for Europe.
HOTEL VICTORIA,
Northumberland Ave., Charing Cross, London, W. C.
Cable Address: - - "Electview," London.
Telegraphic Address: Ffrench, "Victoriola," London.

SUBSCRIPTION TO THE ELECTRICAL REVIEW.
One Year, United States and Canada, - $3.00
One Year. Foreign Countries, - - 5.00
Single Copy, - - - - .10

ANNOUNCEMENT.

Address all communications and make all money orders and checks payable to order of ELECTRICAL REVIEW, P. O. Box 3329, New York.

No attention will be paid to communications for the REVIEW without the *name and address of the writer.*

NEW YORK, APRIL 18, 1891.

CONTENTS.

	PAGE.
Epoch-Making Inventions of America	109
Pueblo is Well Lighted	109
A New Form of Megohm Resistance	109
Failure to Deliver Telegram	109
An Electric Awakener	109
The Prophet's Column	110
The Municipal Signal Company's Police and Fire Alarm Systems	110
Jottings from the Foreign Technical Press	111
New Storage Battery Work—The Electrical Accumulator Company	111
Electrocution News	111
New Corporations	111
Poles in Cincinnati	111
Another Copper Trust	112
Electric Traction for Cities	112
Thomson-Houston Annual Report	113
Telephonic News	114
Electric Clubs:	
New York Electric Club	114
American Institute of Electrical Engineers	114
Fort Wayne, Ind., Electric Club	114
The Inventors of the Telegraph and Telephone	114
Personal	115
Telegraphic	115
Physiological Effects of Alternating Currents	115
Financial	115
Electric Power	116
Chandler's Elevated Tricycle Road	116
The Bristol Belt Line Railway Company	116
A Note from Mr. Olof Dahl	116
The Latest Figures	116
Description of the Reconstructed Factory of the Beiding Motor and Manufacturing Company, Chicago	116
A New Electric Light Switch	117
The Mosher Arc Lamp for Incandescent Circuits	117
New York Belting and Packing Company	117
Central Electric Company's Desk Lamp	117
Realism in the Audience	117
Electric Light News	117
The Highest Economy in the Use of Incandescent Lamps	118
Forty Years in the Field of Advertising	118
Thermopile on the Brain	118
The Effect of Invention Upon the Progress of Electrical Science	119
International Protection of Industrial Property	119
Views, News and Interviews	119
Kindred Interests	120
A New Dry Battery—The "Gladiator"	120
Electrical Patents	120

INDEX OF ADVERTISERS.

COVER PAGES.	PAGE.
Ansonia Brass & Copper Co	xx
Armington & Sims	xx
Bishop Gutta Percha Co	xx
Bridgeport Brass Co	xx
Day's Kerite Insulated Wires	xx
Eastern Electric Cable Co	xx
Edison General Electric Co	xix
Hampson & Co., E. P	xx
Jewell Belting Co	xx
Kennedy, Robert A	xx
Moore, Alfred F	xx
Okonite Co	xx
Standard Underground Cable Co	xx
Thomson-Houston Electric Co	iii
Tucker Electrical Construction Co	xx

INSIDE PAGES.	
Accumulator Co., The	xviii
Alexander, Barney & Chapin	iii
Amateur Electrician	xvii
American Bell Telephone Co	xiii
American Electrical Works	xi
American Electric Elevator Co	vi
Baker & Co	iv
Ball Engine Co	viii
Ball & Wood Co	vii
Barnes Co., W. F. & John	vii
Baxter, H. E. & C	ix
Berlin Iron Bridge Co	vi
Bernstein Electric Co	viii
Brownlee & Co	x
Brush Electric Co	xiv
Buckeye Engine Co	vii
Burton Electric Co	xii
Carhart & Co., E. M	vi
"C. & C." Electric Motor Co	xiii
Central Electric Co	iv
Clark Electric Co	iv
Cralle & Co., J. B	iii
Crocker-Wheeler Motor Co	x
Crosby Electric Co	vi
Dixon Crucible Co	xv
Dwight Slate Machine Co	x
Electrical Supply Co	vi
Electric Merchandise Co	xvii
Electric Secret Service Co	x
Elektron Manufacturing Co	iii
Empire China Works	xii
Empire City Electric Co	xiii
Equitable Engineering and Construction Co	viii
Eureka Electric Co	x
Eureka Tempered Copper Co	iii
Evans Friction Cone Co	xiii
Faraday Carbon Co	ix
Fletcher & Fletcher Electric Co	viii
Foote Regulator Co	vii
Fort Wayne Electric Co	xviii
Garvin Machine Co	vii
Gordon & Co., W. H	xiii
Greeley & Co., The E. S	viii & ix
Heine Safety Boiler Co	vii
Heisler Electric Light Co	x
Holmes, Booth & Haydens	iv
Holtzer-Cabot Electric Co	xii
Hulbert Fence and Wire Co	x
Independent Bung Co	iv
Interior Conduit and Insulation Co	x
International Electrical Exhibition	viii
Kulp, D. H	xvii
Laird & Lee	iii
Lamp Factory for Sale	xi
Lane & Bodley Co	xvii
Leclanche Battery Co	xi
Lehigh Valley Creosoting Co	xv
Maguire, F. Z	xi
Marshall, Wm	xvii
McCreary Electrical Specialty Co	x
Milliken Bros	vii
Nassau Electrical Co	iv
National Carbon Co	iv
National Pipe Bending Co	v
New England Butt Co	vi
New York Belting and Packing Co	ix
New York Safety Steam Power Co	vii
Noye Mfg. Co., John T	vii
Otis Bros. & Co	vi
Ostrander & Co., W. B	viii
Paiste, H. T	120
Palmer Bros	iii
Parker-Russell Mining and Manufacturing Co	ix
Phœnix Glass Co	xi
Phosphor-Bronze Smelting Co., Ltd	xiii
Pond Engineering Co	xiii
Reddaway & Co., F	xv
Ridion & Co	120
Royce & Marean	x
Sawyer-Man Electric Co	xv
Schieren & Co., Chas. A	120
Schuyler Electric Co	iii
Sessions Foundry Co	xv
Shultz Belting Co	iii
Sigourney Tool Co	xvii
Simplex Electrical Co	xi
Solar Carbon & Manufacturing Co	xv
Standard Electric Supply Co	xviii
Standard Paint Co	xi
Stanley & Hall	vi
Star Electrix Co	120
Taylor & Son	xiii
Tropical American Telephone Co	ix
Universal Arc Lamp Co	viii
Vincent & Co., Charles R	vii
Washburn & Moen Manufacturing Co	ix
Watson & Stillman	xv
Western Electric Co	ix
Westinghouse Electric & Mfg. Co	xvii
Weston Electrical Instrument Co	xv
White Dental Manufacturing Co., The S. S	iv
Williams & Potter	xv
Wyckoff, Seamans & Benedict	120

The obstruction to traffic on Broadway just now, caused by the preliminary work for the cable road, is a mere trifle compared to the blocks that will occur when the cable itself is actually in operation.

It is rumored that unexpected difficulties of a very serious nature have been met with in the work of preparing Third avenue and Broadway for the cable conduits, and it would not be surprising if the cable cars were never to make their appearance in these thoroughfares after all.

The Londoner has now an excellent opportunity to improve his French pronunciation. He can go to his own end of the telephone line, call up the French capital, and get the pure Parisian accent on tap without the least trouble. It would prove rather expensive, though, as a half-hour's lesson would foot up to $20. The authorities might, however, accept the idea and get up evening classes at a reduced rate. It would be an easy matter to fit up receivers for a class of 10 or 20 persons, and it would be a most interesting application of science to conduct language lessons by *viva voce*, with the teacher in one country and the pupils in another.

The Massachusetts House Committee on Manufactures has reported, seven to four, against the municipal ownership of gas and electric light plants. Friends of the measure claim that the House will pass the bill. The real fight is to be expected in the Senate.

The work of clearing the streets of telegraph poles wherever the subways are ready for the reception of electric wires is one of which all good citizens will heartily approve. It is gratifying to note that the electric corporations have desisted from unreasonable opposition to this salutary reform. All that the news and light companies can ask is that they should not be forced to break up their aerial routes before subterranean conduits are prepared.—*New York Recorder.*

Just so.

It is becoming quite the fashion now for doctors to discuss the evil effects of the electric light on the eyesight, and all sorts of paragraphs are going the rounds of the daily press describing the injuries to their sight that people have suffered from the use of the incandescent lamp. There would be very little of this talk if people would only use a little common sense in the matter. Many think that because an incandescent lamp does not give out much heat and will not singe their whiskers or their hair, that they must have the lamps right under their nose or half a foot away from their eyes and directly level with them. This sort of thing would be injurious even with a glow-worm lamp, if there were such things. Incandescent lamps need to be properly placed and shaded so as not to cast their rays directly on the eyes, and if these very simple precautions were carried out there would be no need for the silly talk about the injurious effect of the electric light on the eyesight.

London is pushing ahead with underground electric railways, and we in New York are still patiently awaiting the decision of the Rapid Transit Commission. There is a feeling that the Commission is keeping New York waiting a trifle longer than should be necessary, but we can understand that the mass of technical matter that they have had to go through and examine must involve a formidable amount of hard work, and the responsibility of making a final decision in a matter of so much moment is one which may well induce deliberation and caution. There is one thing certain, however, and that is, that electrical engineers all over the country will be greatly disappointed if the Commission does not decide on an electric underground road. There can be no question but that American engineers will construct and equip such a road, if they are called upon to do so, which will be a magnificent example of what rapid transit in a great city should be in this age of electricity.

ANOTHER COPPER TRUST.

It seems that there is another gigantic copper trust scheme looming up. This time it is not a French but an American enterprise, if, indeed, such an undertaking can be called an enterprise. The scheme, we learn, was practically consummated at the Plumbers' Copper-ware Association of the United States, held last week in Philadelphia. Plumbers have not earned a very high reputation for moderation in their ideas as to money-getting (their methods are not generally recognized as justifying the expression money-making), and it is not surprising to find a plumbers' association taking the initiative in a plan to make money by unfair means.

It is said in explanation—not justification—of the inchoate trust, that when, about a year ago, the established schedule of prices was abolished and the market thrown open, a disastrous venture was made by the plumbers and their friends. Competition became strong and prices went down in proportion. Hence, the motive for the new trust, which, of course, is to do away with competition and send prices up again. The question was not definitely settled and the formation of the trust was postponed for two weeks, when the plumbers and their satellites will meet in New York. Electricians all over the country are interested in the prevention of this trust being formed, or in the defeat and humiliation of its projectors if it is formed.

ELECTRIC TRACTION FOR CITIES.

Our evening contemporary, the *Commercial Advertiser*, which has a decided and enlightened fondness for scientific matters, which, in a daily journal, is a most cheering sign of the times, asks the question, in a recent editorial, Can New York replace car horses? The immediate motive for such a question is the announced withdrawal of the Julien storage battery cars from the Madison and Fourth avenue line. It is rightly held that the trolley system is impossible in New York, and it might have been further prophesied that the day will come when the trolley wire shall have disappeared from the streets of all large cities. There remain, then, for surface electric traction, the storage battery and the underground conduit. The storage battery has been found wanting, and the successful underground conduit system has not yet been invented; the *Commercial*, therefore, finds the outlook for surface electric traction in New York somewhat discouraging.

The storage battery car is the ideal city electric car, and that before very long it will be in successful commercial operation in many large cities no progressive electrical engineer is willing to doubt. The fact that the few cars which have for so long afforded New Yorkers an object lesson in the progress of electric traction are to be, in daily newspaper language, "relegated to innocuous desuetude" is to be regretted, but it can by no means be construed as a proof that the storage battery car is not a success, commercially speaking. It has been proved to be a success as far as electrical and mechanical considerations are concerned, and the regularity of the service in respect to freedom from breakdowns has been all that could be desired. The weak point has been that the experiment has been tried on too small a scale. If a hundred or more cars, instead of some 10 or 12, had been equipped, the financial results would have been very different.

The advances made during the past few years in the direction of underground conduit systems have so far been unproductive of any very striking results, although much steady work has been done in this direction. To prophecy that a practicable system will be produced before the world is many years older (in fact, in dealing with electricity, whose development is so rapid, we might say months instead of years), is to make a very safe prophecy indeed, as the entire history of electrical and mechanical invention points to such a conclusion. The storage battery is susceptible of many improvements, chiefly in respect to increasing its durability, and it can relegate the horses to "innocuous desuetude" if applied on a sufficiently large scale.

The *Commercial*, referring to the law recently passed, which provides that after a certain date no car shall be operated in the streets of Washington by horses, by steam or by any overhead construction, says that as cable traction is impossible in Washington, the city is left by law either to underground electric conduits or to a storage battery system, and concludes with these words: "Electricians have almost unanimously discredited the use of either. Both have failed in New York and elsewhere."

One generally expects to find, and almost always does find, these sweepingly incorrect statements in newspaper articles on scientific matters. It is not by any means true that electricians "almost unanimously discredit the use" of either the storage battery system or the underground conduit. Many electricians undoubtedly champion the former as it is to day, and very few would be willing to question the ultimate success of either. It is not worth while to discuss the failures of underground conduit systems, because none has really been tried except experimentally, and their day is not yet come. The storage battery can tell a very different tale if it is given a fair trial.

The press of the United States have been laboring with the telegraph, telephone and electric light and power companies, for several years to induce them to put their wires underground.—*Springfield, Mass., News.*

"Press have been" is good; "laboring with" is also good. All gall is divided into three parts, of which the *News* owns two and nine-tenths. A paper which starts an opinion with such an assertion as that quoted would not learn much, even if told of all the difficulties the electric companies have to contend with to get wires underground.

THOMSON-HOUSTON ANNUAL REPORT.

A MAGNIFICENT SHOWING BY A GREAT AND PROGRESSIVE ELECTRIC LIGHT COMPANY.

The annual meeting of the stockholders of the Thomson-Houston Electric Company, of Boston, was held in Middletown, Conn., on Monday of this week, President Pevear in the chair. The report made to the stockholders is published herewith and is remarkable evidence of the growth and expansion of this company under its able and far-seeing management.

THE REPORT.

To the Stockholders of the Thomson-Houston Electric Company:

During the fiscal year just closed there has been added to your company a large number of shareholders, many of them residing at a distance, and an increasing number in England. It may be interesting to these to be furnished with information concerning the early history of the company with which most of the older stockholders are familiar.

In the year 1880 the American Electric Company, the immediate predecessor of the Thomson-Houston Electric Company, was organized under the laws of the State of Connecticut with a capital stock of $125,000. It commenced manufacture in that State in a small wooden factory in New Britain. In addition to the unfortunate early management of the company, it suffered from inadequate capital, and, as a result, accomplished only a small degree of success during the first two years of its existence. The value of its patents and system was, however, widely recognized, and representatives of various competing companies made attempts to obtain control of the company. In October, 1882, after several months spent in very careful study of its patents, the present management of your company secured control of its capital stock and, as a mark of respect to the inventors, Professors Elihu Thomson and E. J. Houston, the name was changed to the one it now bears—The Thomson-Houston Electric Company. In the Autumn of 1883 manufacturing was commenced in large new shops in Lynn, which were constructed in the most thorough manner and equipped with the highest class of machinery and tools. Since that time the company has constructed and equipped one or more additional factories each year, occupying at the present time a group of 11 conveniently arranged factory buildings. The growth from that date until the present time is shown by the following statement of annual business from the year 1883 to 1890, inclusive:

1883	$426,987.97
1884	700,470.46
1885	983,996.05
1886	1,405,041.74
1887	2,335,594.80
1888	4,435,902.23
1889	8,222,789.12
1890	10,617,661.67

The above amounts embrace only the transactions of the Boston office and do not include business secured from the operations of the different branch offices of the company. Such business, added to that of the Boston office, would increase the operations above given about 25 per cent.

The volume of business done by your company, and the manufacturing companies allied with it, is believed to be far in excess of the aggregate business of all the other electrical companies in the country.

ALLIANCES WITH OTHER MANUFACTURING COMPANIES.

From 1882 until 1888, active competition was experienced from numerous manufacturing companies of more or less strength, which was so severe as to seriously affect the profits of the business as well as to render it necessary to take a considerable amount of the securities of local companies in payment for apparatus. Since 1887, however, alliances have been made with most of the manufacturing companies controlling important patent systems, which have resulted in increasing the profits of your company by checking the severe competition which existed prior thereto. The companies with which the Thomson-Houston Electric Company has effected close alliances include the following: The Brush Electric Company, of Cleveland, O.; the Fort Wayne Electric Company, of Fort Wayne, Ind.; the Schuyler Electric Company, of Middletown, Conn.; the Excelsior Electric Company, of New York city; the Van Depoele Electric Manufacturing Company, of Chicago, Ill.; the Indianapolis Jenney Electric Company, of Indianapolis, Ind., and the Bentley-Knight Electric Company, of New York. As a result of these alliances, the factories of the Van Depoele Electric Company, the Indianapolis Jenney Electric Company and the Bentley-Knight Electric Company, of New York, have been closed; the business formerly done by these three corporations being now taken care of at the shops of the other companies. All of these companies, and the able management by which they were represented, instead of being in active and bitter business competition and legal contention with the Thomson-Houston Electric Company, are now working in harmony with its interests. The advantages of the relations which have been established are manifest in the greatly increased prosperity of the Thomson-Houston as well as that of the allied companies. Your company has also secured control of the well-known Hunter patents, formerly owned by the Electric Car Company of America.

PATENT SITUATION.

It has always been the policy of the company to avoid unnecessary litigation, while at the same time it has endeavored, and with success, to secure the greatest benefit of its own patents.

As is well known, the only two electric lighting patents that have been sustained up to the present time, are the regulator patent of the Thomson-Houston Electric Company and the double lamp patent of the Brush Company.

The fundamental patent of Charles F. Brush on the modern form of storage battery, which patent is owned by the Brush Company, has also been sustained by the courts after a vigorous contest, with a construction which brings within its scope all storage batteries that are now in commercial use. The Brush Company controls a very large number of patents on storage batteries, and, as far as now can be foreseen, no practical storage battery can be made without directly infringing them.

We have every reason to be satisfied with the general patent situation, and believe that the result of the litigation now pending cannot be other than favorable to us.

LOCAL ORGANIZATIONS FOR SUPPLYING LIGHT AND POWER.

The prosperity of an electric manufacturing company and the value of its business is to a very large degree measured by the number of local lighting and power corporations using its apparatus. While some electric manufacturing companies have confined their operations principally to the supply of mills, factories, hotels, etc., with electrical apparatus, which is known as "Isolated" business, and which is of inferior value and importance, nearly 90 per cent. of the business of your company has been in the sale of its apparatus to corporations organized to furnish light and power from central lighting and power stations. The business of these corporations is profitable and constantly increasing, and the orders received from them for increased plant and for renewal apparatus and supplies are secured with comparatively little solicitation or expense, and are chiefly for cash. On the first of January, 1891, there were in the United States alone nearly 1,000 substantial local companies using the system of the Thomson-Houston Electric Company. According to carefully prepared tables, this is about three times the number of local companies using the system of the next largest existing company engaged in the manufacture of electrical apparatus. If to the above are added the lighting and power stations of the companies working in alliance with the Thomson-Houston Electric Company, the number reaches 1,500, or more than double the aggregate of those using the apparatus of all other systems in the country.

SECURITIES OF LOCAL LIGHTING AND POWER COMPANIES OWNED BY THE THOMSON-HOUSTON ELECTRIC COMPANY.

While it was the practice of the Thomson-Houston Company from time to time, during the period of severe competition with the manufacturing companies subsequently allied with it, to take a certain portion of the securities of local companies in payment for apparatus or for territorial rights, this is now done to a much less extent in proportion to its business. The entire sum of all stocks of local lighting and railway companies now owned by the Thomson-Houston Company is very inconsiderable, the aggregate being less than two per cent. of its assets at the present time.

The company has a somewhat larger amount of the first mortgage bonds of such companies, though considerably less than ten per cent. of its entire assets are represented thereby.

THE BUSINESS DEPARTMENTS OF THE THOMSON-HOUSTON COMPANY.

Your management has found it very advantageous to divide the operations of the company into different departments, holding the heads of such departments to strict accountability for their success.

The railway department is thoroughly organized, and under exceedingly competent and aggressive management.

The isolated department has been established for the purpose of supplying mills, hotels, factories, etc., with lighting plants, and is doing a large and increasing business.

The Thomson-Houston Motor Company was organized about two years ago for the purpose of furnishing stationary motors for various manufacturing purposes, selling to central power stations, etc., and has been very successful.

The mining department has been lately established for equipping mines with machinery for drilling, hoisting, pumping, hauling, lighting, etc., and is of very great prospective value and importance. While this department is yet in its infancy, it promises to add very largely to the business and profits of the company.

ACCOUNTING DEPARTMENT.

For the last three years, in addition to the competent experts in charge of the accounting department of the company, it has been our practice to employ Mr. Henry A. Piper, one of the best known and most accomplished expert public accountants in New England, to go carefully over and supervise the work of our own experts, thus giving the directors of your company a feeling of security as to the exact condition of the affairs, not only of the Thomson-Houston Company, but of its various branch offices and the manufacturing corporations with which it is allied.

BRANCH OFFICES.

Early in the history of the company it became evident that the business in distant sections of the country could not be effectually pushed without the establishment of branch offices which should be in closer touch, and more frequent communication with the cities and towns it was desired to reach. There are now branch offices at New York city, Syracuse, N. Y., Philadelphia, Washington, D. C., Atlanta, Ga., Cincinnati, O., Chicago, St. Louis, St. Paul, San Francisco and Portland, Oregon. The results following the establishment of these offices have been most gratifying and have been of the highest importance to the success of the company. There is now no section of the country which is not under the immediate and careful supervision of some one of the different offices above mentioned.

In several instances these offices are represented by organized companies and appear under the head of "Construction Companies." In such cases active and influential local interests have been secured from resident stockholders. In all these "Construction Companies" the Thomson-Houston Company retains a controlling interest.

FINANCIAL CONDITION OF THE COMPANY.

Your directors have reason to congratulate you upon the greatly improved condition of the finances of the company. A year and a half ago the direct liabilities of the company were more than a million and a quarter of dollars in access of those at the present time, and in addition thereto it had unmatured payments, on account of contracts for the purchase of the Brush and other manufacturing companies, of about two and one-half millions of dollars. These have all been met, so that the reduction of all obligations of the company is more than three and one-half millions of dollars. There is no present indication that your directors will recommend the acquisition of any manufacturing property other than those already acquired.

It is believed that the net earnings of the company will justify the continued payment of dividends on the common stock at the rate of one dollar per share quarterly, and that, in addition thereto, the company can largely add to its surplus account.

The following table will be of interest to stockholders as showing the additions which have been made to the capital stock of the company since 1883:

ADDITIONS TO CAPITAL STOCK SINCE 1882.

Original capital, 5,000 shares at $25 per share	$125,000
May, 1887—Received cash for 15,000 shares common stock at $25 per share	375,000
March, 1888—Received cash for 20,000 shares common stock at $25 per share	500,000
April, 1889—Received cash for 40,000 shares common stock at $25 per share	1,000,000
April, 1889—Received cash for 40,000 shares preferred stock at $25 per share	1,000,000
October, 1889—Received cash for 60,000 shares common stock at $25 per share	1,500,000
December, 1889—Received cash for 120,000 shares preferred stock at $25 per share	3,000,000
September, 1890—Received cash for 60,000 shares common stock at $50 per share	3,000,000
Total	$10,500,000
In addition to the Cash received from sales of stock as above, there was taken from the Surplus Account in April, 1889, $1,000,000 and 40,000 shares of common stock were issued therefor to the stockholders, on basis of $25 per share	1,000,000
Total	$11,500,000

TOTAL CAPITAL STOCK AUTHORIZED AND ISSUED.

Common Stock	$6,000,000
Preferred Stock	4,000,000

It will thus be seen that the amount of cash invested in the shares of the company exceeds the total issued common and preferred stock by $1,500,000.

DIVISION OF PROFITS AMONG THOMSON-HOUSTON STOCKHOLDERS UP TO THE PRESENT TIME.

It may be proper, in view of the policy recently adopted of paying cash dividends to the holders of the common stock, to refer to the dividends which have heretofore been received by the stockholders of the company in other than cash payments.

The profits received from the different "series" of trust securities, together with dividend of 40,000 shares of common stock computed at $25 per share, have been equivalent to an average annual dividend to the holders of the common stock of a little more than $14 per share during the eight years of the present management of the company. This has no reference to and does not include the large amounts paid from time to time for rights to subscribe to new issues of the common stock of the company. In addition to these dividends there is an accrued surplus derived from the profits of the company, exclusive of premium received from the sale of common stock, of $4,522,533.71.

The liabilities of the company, as set forth below, do not include $500,000 Thomson-Houston collateral trust bonds which were issued in 1889 as an accommodation to the Manhattan Electric Company, of New York. The Manhattan Company, besides assuming the entire burden of paying the principal and interest of these bonds, has supplied the Thomson-Houston Company, without cost to it, with ample security for the use of its name, which was granted for valuable considerations received from the Manhattan Company.

PROSPECTS FOR FUTURE BUSINESS.

While it is not to be expected that the business of the company will continue to increase in the future as rapidly as in the past, the almost universal prosperity and rapid growth of the local companies organized to use the Thomson-Houston system is a guarantee of the permanent prosperity of its business. In view of the present widespread depression of all business interests, it is a source of congratulation that the orders received by your company for the last 90 days are considerably in excess of those for the same period for any previous year.

By order of the Board of Directors.

C. A. COFFIN, *Treasurer.*

THOMSON-HOUSTON ELECTRIC COMPANY.

Balance Sheet, January 31, 1891.

ASSETS.

Acc'ts receivable, mdse., Less deductions, (a)	$6,505,117 74 650,511 77	$5,854,605 97
Notes receivable, Less deductions, (b)	$1,752,799 25 87,639 95	1,665,159 30
Cash,		632,055 18
Real estate, about 70 per cent. of cost,		350,000 00
Machinery and tools, about 70 per cent. of cost,		400,000 00
Patterns and models,		135,000 00
Patents, (c)	$438,354 29	
Less deductions, in addition to previous deductions,	100,000 00	338,354 29
Local Co.'s stock, 40 per cent. of par, (d)		346,430 00
Local Co.'s bonds, 70 per cent. of par, (d)		1,646,120 00
Manufacturing Co.'s stock, at cost, (e)		3,821,017 50
Construction Co.'s stock at cost, (f)		1,022,500 00
United Securities Co.'s stock, at cost, (g)		487,425 00
Consignments,		14,095 63
Merchandise inventory, (h)		1,476,589 15
Supply department inventory,		53,554 68
Common stock, sold but not delivered, (i)		331,100 00
Premium on Common Stock sold but not delivered, (i)		331,100 00
		$18,905,106 70

THOMSON-HOUSTON ELECTRIC COMPANY.

Balance Sheet, January 31, 1891.

LIABILITIES.

Capital stock, common,		$6,000,000 00
Capital stock, preferred,		4,000,000 00
Accounts payable, merchandise,		374,340 60
Notes payable, collateral,		1,537,356 97
Notes payable, unsecured,		765,350 64
Mortgage,		1,200 00
Accrued wages,		4,124 78
Guarantee account (from accrued surplus),		200,000 00
Surplus February 1, 1890,		1,685,415 92
Profits for the year,	$3,091,883 67	
Premium on common stock sold,	1,500,000 00	
Total,	$4,591,883 67	
Less dividends paid on preferred stock,	254,765 88	4,337,117 79
		$18,905,106 70

STATEMENT OF SURPLUS ACCOUNT.

Surplus February 1, 1890,	$1,685,415 92
Increase for year ending January 31, 1891,	4,337,117 79
Surplus January 31, 1891,	$6,022,533 71

C. A. COFFIN, *Treasurer.*

(*Continued on page* 114.)

Telephonic News

*** A severe storm crippled the long distance telephone service in Massachusetts the night of April 2.

*** A new 100-wire cable has just been put in at the Berkely, Cal., central telephone station.

*** 1,800 miles of wire were added to the Indian telegraphic system last year, and the profit on the operations of the year amounted to about 21 lakhs of rupees.

*** A movement is on foot to establish a telephone line between Dalton and Chattanooga, Tenn., and efforts will be made to get Chattanooga merchants interested in it.

*** According to the Brussels correspondent of the *London Times*, the question of establishing telephonic communication between Brussels and London is under consideration.

*** The Moline, Ill., telephone office is to be equipped with an additional switchboard, with a capacity for 50 more connections. The present boards, with their 150 connections, are now fully occupied.

ELECTRIC CLUBS.

New York Electric Club.

A Table d'Hote Dinner Thursday evening of each week would meet with appreciation and patronage, it is thought. A number of members who are frequent visitors at the Club house have expressed a desire for a *table d'hote* dinner at least once a week, and it is hoped that the matter will be given a trial.

Mr. F. C. Mason, of Brooklyn, entertained a number of gentlemen at dinner Thursday evening of last week.

The Annual Election occurs Thursday, April 16. The polls will be open from 5 to 8 P. M. Every active member is earnestly requested to be present and support the candidate of his choice. An interesting election is in sight and it is expected that the largest vote ever taken in the Club will be polled.

Gen. O. E. Madden, who has held the presidency of the Club for the past year and a half, has declined a nomination for re-election. General Madden has been an enthusiastic and able president and has devoted much of his valuable time to furthering the interests of the Club. He has maintained the high standard of excellence which pervades every department and makes the Electric Club so well known as a progressive and instructive organization. His declination leaves the field open, and several good men are being talked of for this honorable distinction.

A Long List of new members was elected Thursday evening of last week. Among these were Dr. E. R. Chadbourne, J. G. Slonecker, A. St. Clair Vance, Chas. T. Hughes, Norman McD. Crawford, F. M. Pierce, Geo. W. Silsby, C. A. Gundacker, Jr., W. R. Fleming, W. G. Whitmore, Duncan C. Robertson, Howard L. Woody, Samuel H. Pine, W. K. Stern and Geo. L. Colgate.

A Member who is having trouble with his electric house wiring got off the following at the Electric Club the other evening:

When is an electrician not an electrician?
Answer: Nineteen times out of 20.

American Institute of Electrical Engineers.

The Fifty-sixth Meeting of the Institute will be held on Tuesday evening, April 21, at 8 o'clock, at the rooms of the Institute, No. 12 West Thirty-first street, near Fifth avenue. A paper will be read by Mr. Alexander S. Brown, of Boonton, N. J., entitled "The Electrical Extraction of Aluminium." The paper will be illustrated with electric lantern slides. Members who are especially interested in the subject may be supplied with advance copies upon application to the secretary. The council will meet in the secretary's office at 5 P. M.

A Paper will also be read by Mr. N. D. C. Hodges, editor of *Science*, on "A New Theory and Practice of Protection Against Lightning."

The Annual and General Meetings of the Institute will be held in this city, May 19, 20 and 21. Full particulars of these meetings will be given later.

Fort Wayne, Ind., Electric Club.

The Members are considering the advisability of joining with the Commercial Club, of Fort Wayne, to form a new organization to be called the Commercial Electric Club of Fort Wayne. The scheme includes the building of a new Club house.

THOMSON-HOUSTON ANNUAL REPORT.

(*Continued from page* 113.)

(*a*) While the total amount of open accounts is large, the average of each account is small, the company having about 2,400 active customers, many of whose accounts vary from $25,000 to $100,000. A discount of 10 per cent. has been made, which is believed to be more than enough to provide for all possible shrinkage. There is included in accounts receivable about $500,000 of what are carried on our books as "construction accounts," the same being work on uncompleted contracts entered on our books at cost, without any addition to cover expenses of agents' commissions, etc. These, when completed and charged directly to purchasers, will considerably swell the profit account.

(*b*) While it is believed that all these notes are good, a discount of five per cent. is made for contingencies. The company has, during the past seven years, suffered an annual loss of less than one-quarter of one per cent. of its accounts from the failure of its customers to meet their obligations in full.

(*c*) The patent account is believed to represent but a small fraction of the value which might conservatively be placed upon this portion of our assets. It embraces about 1,000 different patents, many of them of fundamental character, and of controlling importance. It has always been the policy of the company to carry its patents at a merely nominal value on its books.

(*d*) In making the large deductions from the face value of the first mortgage bonds and local company stocks, the company has followed the conservative policy adopted in previous years. Nearly all the bonds are payable in gold, with sinking fund and other protective provisions. The deeds of trust securing them have been carefully prepared under the direction of competent attorneys of our own selection.

(*e*) These stocks, which include those of the Brush, Fort Wayne and other manufacturing companies enumerated in the foregoing report, are taken at their cost value, and are making very satisfactory earnings.

(*f*) These stocks are taken at their cost value, and the companies represented thereby are doing a very profitable business, and have greatly contributed to the successful operations of the Thomson-Houston Company.

(*g*) The United Securities Company is a successful corporation working in harmony with the Thomson-Houston Company. Its stock is taken at cost, and as with the other classes of stock enumerated above, no account is made of the accrued profits of the company.

(*h*) The inventory of material and merchandise at factory has been taken at less than actual cost to conform to present prices of material. A large percentage of the stock was, at the time of the inventory, sold for future delivery.

(*i*) It will be remembered that by the terms of the subscription to the common stock, made in October (16,000 shares—$800,000), were made payable April 15, 1891. These amounts (aggregating $662,400) represent the unpaid portion of that subscription February 1, 1891, the balance having been anticipated by the subscribers.

A furniture and fixture account of about $30,000, which has heretofore been carried on our books, has been charged off from last year's earnings.

LOCAL COMPANIES USING THE THOMSON-HOUSTON ARC AND INCANDESCENT LIGHTING SYSTEM IN THE UNITED STATES.

	No. of Companies.	No. of Arc lamps.
January 1, 1883.....	5	365
January 1, 1884.....	31	2,478
January 1, 1885.....	59	5,867
January 1, 1886.....	100	13,227
January 1, 1887	171	21,840
January 1, 1888.....	303	36,936
January 1, 1889.....	419	51,621
January 1, 1890.....	587	68,203
January 1, 1891.....	755	87,131

There are companies operating this system in England, Ireland, Sweden, South and Central America, Finland, France, Germany, Italy, Spain, Russia, Japan, West Indies, Australia; in fact, in nearly every civilized country in the world not included in the above.

Of the above, about 500 companies operate both arc and incandescent, employing between 600,000 to 700,000 incandescent lights of the Thomson-Houston manufacture.

We have also many hundreds of isolated plants in factories, hotels, etc., the number of which is rapidly increasing.

We have more than 150 lines of electric railways under contract and in operation, aggregating over 2,000 cars, as a result of less than three years' operation of this department.

STATEMENT OF PROFITS AND SURPLUS ACCOUNT.

	Added to Surplus from Profits.	Total Surplus.
January 1, 1883.....	$17,237.85	.....
January 1, 1884.....	93,696.74	$110,934.59
January 1, 1885.....	96,187.10	207,111.69
January 1, 1886.....	106,687.50	313,809.19
January 1, 1887.....	123,006.05	436,815.23
February 1, 1888.....	313,596.67	750,411.91
February 1, 1889.....	660,828.82	1,411,240.73
February 1, 1890.....1,309,175.19		1,685,515.62
February 2, 1891.....4,337,117.79		6,022,583.71

The surplus account February 1, 1889, was $1,411,240.73; *from which* there was divided among the shareholders $1,000,000 as stock dividend and a cash dividend of $35,000 on preferred stock. There was *added* from the profits of the year 1889, $1,309,175.19, making a surplus February 1, 1890, $1,685,415.92.

In explanation of the small increase in the surplus of 1890 over that of 1889, it should be stated that there were delivered to trustees of Thomson-Houston trust securities "Series D" as a dividend to holders of the common stock, securities and claims amounting at face value to $2,410,289.13.

THE NEW BOARD.

The following named gentlemen were elected directors of the company for the ensuing year: Henry A. Pevear, Charles A. Coffin, Joseph N. Smith, Benjamin F. Spinney, Charles B. Newhall, T. Jefferson Coolidge, S. Endicott Peabody, Elihu Thomson and Frederick P. Fish.

The Inventors of the Telegraph and Telephone.

ABSTRACT OF ADDRESS BY PROF. THOMAS GRAY, OF ROSE POLYTECHNIC INSTITUTE, TERRE HAUTE, IND., BEFORE THE INVENTORS' CONGRESS.

To telegraph literally means to write at a distance, but this is not the popular meaning of the term. When we speak of telegraphing we have simply in mind the conveying of intelligence to a distance. In this sense there are a great many kinds of telegraphs; for example, hydraulic telegraphs, pneumatic telegraphs, flag telegraphs, semaphores, flash lights, beacon fires and so on, besides the one which is now most commonly associated with the name—the electric telegraph.

One of the earliest telegraphs was that introduced about the middle of the 17th century by the Duke of York (afterwards James II of England), who was then admiral of the English fleet. This was the flag telegraph, still used for communicating between ships at sea, originally introduced for directing the manœuvres of the fleet. In 1694 Dr. Hooke proposed to telegraph by means of objects of different shapes hung on high poles, and a century later the French government adopted the semaphore of M. Chappe. Like the flag signals, the semaphore has been found useful and is still largely used for railway signals. The chief interest of these early telegraphs, a great many forms of which might be enumerated, is in illustrating the recognized importance of some means of conveying intelligence quickly to a distance. The telegraph of to-day is almost entirely electrical, and, in its present form, is of comparatively recent growth. It may be well, however, to glance very briefly at some of the early attempts to use electricity and magnetism as a means of telegraphing to a distance. In the year 1617 we find an allusion made in one of Strada's Prolusiones Academicæ to the belief that there existed a sympathy between needles which had been touched by a species of loadstone which caused them always to set parallel to each other. Two such needles, it was said, could be used as a telegraph because, if they were pivoted on a card marked with words or letters, when one was pointed to any mark the other would point to the corresponding mark on the other card. The same belief is referred to by Galileo in one of his dialogues, in 1632, and again by the Abbe Barthelemy in a work entitled "Voyage du Jeune Anacharsis," published in 1788. So far this may be said to be mere fable.

The discovery of Stephen Gray, in 1729, that the electrical influence produced by friction could be transmitted to a distance by means of an insulated wire, is probably the first of direct influence in connection with telegraphy. As a result of this discovery, telegraphs were proposed by Morrison in 1753, by Bissolus in 1767, by Le Saye in 1774, by Lomond and by Betancourt in 1787 (both the latter proposing single wires and an alphabet of figures), the illuminated letter telegraph of Reusser in 1794, the spark telegraph of Cavallo in 1795, and the dial telegraph of Ronalds as late as 1816.

In the year 1767, an important observation was made by Sulser. He found that, when a plate of one metal was placed above the tongue, and a plate of another metal was placed below it, and the two metals were allowed to touch outside the tongue, a peculiar sensation and taste was produced. The explanation of this was not found until the well-known experiments of Galvani gave fresh impetus to the subject. The discoveries of Volta and the invention of the voltaic pile and battery shortly followed. In the same year (1800) an attempt to close a voltaic circuit by a drop of water led Nicholson and Carlisle to the discovery that water is decomposed by the galvanic current.

This gave rise to the galvanic or electrolysis telegraphs of Lommering, Coxe and Sharpe, and is the basis of all the chemical printing and copying telegraphs which have in more recent times been produced.

The most important discovery which influenced telegraphy was made by Romagnosi, of Trente, in 1805, but received very little attention until it was rediscovered by Oersted in 1819. This was the discovery that a wire conveying an electric current is capable of deflecting a magnetic needle. In the following year Schweigger discovered that the deflecting force was increased by winding the wire into a coil surrounding the needle. These two discoveries formed the foundation for the galvanoscopes and galvanometers, since so much used in electrical appliances and measurements. One of the most extensive applications was to telegraphy.

Galvanoscopic, or, as they have been more commonly called, needle telegraphs resulted very shortly from these discoveries. In this field of invention we find prominent the distinguished names of Ampere, Gauss and Weber. Ampere proposed a multiple wire telegraph with galvanoscope indicators in 1820. A similar telegraph was proposed by Ritchie and exhibited some years later by Alexander, of Edinburgh. A single circuit telegraph was invented by Tribavillet in 1828, in which a galvanoscope was used as the indicator. In 1832 Schilling produced a five-needle telegraph, which was shortly afterwards simplified to one needle. Two wires were, of course, used, the earth circuit being unknown to him, but otherwise this is the needle telegraph from which all the modern single and multiple needle telegraphs sprang. In the following year a modification of Schilling's telegraph was used by Gauss and Weber for experimental purposes and for the regulation of clocks. The modification introduced by these experimenters was the use of induced currents instead of the galvanic battery. This was an application of the important discoveries of Faraday and Henry in induced magnetism, which have borne so very important fruit in the field of dynamo-electric machinery. On the recommendation of Gauss, this telegraph was taken up by Steinheil, who also used induced currents. The important contributions of Steinheil were the discovery of the earth circuit, the invention of a telegraphic alphabet and a recording telegraph. Of these, the earth circuit was a discovery of great value. This discovery dates from 1837. Previous to the date here reached another epoch making discovery had been made, which has had great influence in telegraphy. This was the discovery of the magnetizing influence of the current. The discovery of Oersted was followed up by Ampere in a long series of researches, in which, among other things, he established the mutual attractions and repulsions of wires carrying currents; the fact that the voltaic element itself acted as a magnet like any other part of the circuit, and that a spiral part of a circuit would magnetize needles. In the same year M. Arago found that a wire conveying an electric current attracted iron filings, and in 1824 the law of the variation of the magnetic force at different distances from the wire was investigated by Barlow. In 1825 Sturgeon found that a bar of soft iron was rendered temporarily magnetic if surrounded by a spiral of wire carrying an electric current. In the year 1827 Ohm propounded his celebrated law of the conduction of currents. In 1831 Faraday, in England, and Henry, in America, discovered the induction of currents by currents and by magnets. We see from these leading facts, that in the 12 years succeeding Oersted's discovery, the knowledge of electricity and electro-magnetism in the directions important for telegraphic application was very great, and we shall see that it very quickly bore fruit.

A copy of Schilling's telegraphic apparatus exhibited by Prof. Muncke, at Heidelburg, in 1836, gave the idea of an electric telegraph to Cooke. Cooke immediately set to work to construct a telegraph on a similar plan and worked out several schemes which he had partially succeeded in introducing on the railway systems in England. Through some difficulty with an electro-magnetic arrangement he was led to consult Prof. Wheatstone and a partnership soon followed which led the latter to devote considerable attention to the subject. The result has been the production of a great variety of apparatus of great value and ingenuity.

The first to propose a recording telegraph seems to have been Prof. Morse, of New York. This invention dates back to 1832, according to a considerable amount of evidence brought forward by Morse, and a rough model existed as early as 1835. In this telegraph an electro-magnet is used as the motor, and Morse claimed not only the first recording telegraph, but also the first application of the electro-magnet in telegraphy. There can be no doubt, however, that the credit of having first used the electro-magnet for telegraphic purposes is due to Prof. Henry, then a teacher in Albany Academy. To Prof. Henry belongs not only the credit of using the electro-magnet for this purpose, but also that of having developed the discovery of Sturgeon to such an extent as to enable any one to make a magnet which would be of service as a receiver on a long telegraph line. Another important invention, in this connection, has to be given to Henry. While experimenting on the electro-magnet he turned his attention to the construction of an electro-magnetic engine and in connection with it contrived a method of closing the circuit of the engine from a distance by means of an auxiliary circuit and an electro-magnet. This is the electro-magnetic relay afterways re-invented by Morse, and now used on nearly all important telegraph circuits. We see, therefore, that the credit of the application of the electro-magnet to telegraphic purposes was of American origin but that it was not first, as is popularly believed, made by Morse. The conception, however, of a telegraph by Morse, whether it originated with him or not, has proved of great value. He, in conjunction with Vail, worked it out on a practical scale, perfected details, invented the Morse alphabet, and

last, though not least, succeeded, after a great amount of trouble and many disappointments, in obtaining the support of Congress towards making it a national enterprise. Previous to the year 1842, when Congress passed an appropriation for experiments with the electric telegraph, the application of electricity to this purpose had gone practically beyond the experimental stage in Europe, the single and double needle instrument being used for indicating the signals. It has been long popularly believed in this country that Morse invented the electric telegraph. In the same way it was long popularly believed in England that Wheatstone did so, and similarly in other countries. It will be seen, however, from the brief sketch here given that the invention of the electric telegraph does not belong to any one man or to any one country. It has grown with scientific knowledge, and forms, as it stands today, one of the best illustrations we have of the value of purely experimental investigation.

From this time until the question of using one wire for more than one message at one time and the problems of submarine telegraphy arose, no new scientific principle was required. Methods of recording and indicating signals multiplied and mechanical contrivances of great beauty were invented for many of these, but the discoveries of Volta, of Oersted and Schweigger, of Nicholson and Carlisle, of Sturgeon, and of Faraday and Henry, were enough from the electrical standpoint for them all. Of the different methods which were invented in the next quarter of a century we may mention the chemical telegraphs of Davy, Bain and others; the dial telegraphs of Wheatstone, Brequet, Froment, Siemens, Chester, Kramer; the automatic telegraphs of Bain, Siemens and Halske, Garnier, Humaston, Wheatstone; the copying telegraph of Bakewell, and the pantelegraph of Casselli; the type printing telegraph of Vail, Wheatstone, House and Hughes. In more recent times many of these inventors and a host of others, including, in this country, the names of Bell, Calahan, Delany, Edison, Gray, Laws, Little, Park, Phelps, Prescott, Smith, Stearns, and many more have added important contributions to the subject. The type printing instruments produced by several of these inventors are triumphs of mechanical ingenuity, which find few equals in any branch of mechanical industry.

As distinct from the instrumental improvements in telegraphy, the next important advance was multiple transmission. A solution of the problem of transmitting simultaneously from both ends of the same line wire was first attempted in 1853 by Gintl, of Vienna, and again in the following year by Frischen and by Siemens and Halske. The methods proposed by these inventors were mechanically sufficient for the purpose, but they overlooked an important factor which had not hitherto been considered important in land line telegraphs—the electrostatic capacity of the line. This difficulty was first successfully overcome by Stearns, of Boston, at the close of 1871 and since that time duplex working, as this system is called, has become quite common. The application of Stearns' method to submarine telegraphy involved peculiar difficulties on account of the very large capacity of the line and, on the more important cables, the great length of the circuit. The credit of having completely overcome these difficulties for cables is due mainly to Dr. Muirhead, of London. The chief workers in this field were Gintl, Frischen, Siemens and Halske, Van Nedden, Preece, Farmer, Nystrom, Mason, Vaes, Winter, Stearns and Muirhead. Next, the problem of how to send two messages in the same direction and, combined with the duplex, the consequent transmission of four messages simultaneously over the same wire was attacked. This was first proposed by Dr. Stark, of Vienna, in 1855, and was subsequently worked at by Borscha, Kramer, Maron, Schaak, Schreder, Wortman and others. The first to obtain satisfactory results was Edison, who invented his method in 1874. Successful systems of quadruplex have since been invented by Smith, and by Smith and Prescott jointly.

Another system of multiple transmission was proposed by Moses G. Farmer, of Salem, Mass., in 1852, in which, by a commutating arrangement, the main line wire was put in rapid succession in contact with a series of branch wires. By proper connection at the sending station, and two commutators worked in unison, it was thus proposed to divide up the transmitting capacity of the main line wire among a number of branch wires so that transmission might go on to all of them at the same time. A similar arrangement was proposed by Meyer and was shown in operation at the Vienna Exhibition in 1873. The same principle is adopted in Delany's telegraph devised a few years ago and in successful operation in various parts of the world.

Distinct from these is the harmonic telegraphs of Gray, Edison and Bell. In this system, which has been most completely worked out by Gray, any number of messages may be sent simultaneously without reference to speed of transmission. In principle, the method consists in causing a number of vibrating reeds of different pitch at one end to produce vibrations in a corresponding set of reeds at the other end of the line, each of the receiving reeds picking out the vibrations which has the same frequency as that of its own vibration.

Although the mere extension of telegraphs from land to submarine lines can hardly be called an invention, yet, very many new problems presented themselves for solution in this extension. Many of these problems were of a more purely scientific character than those presented in the developments which had been in progress, and, consequently, tested the knowledge of the laws of electricity then existing much more severely. It was very soon discovered, for example, that the rate at which signals could be transmitted, and the battery power or other electro-motive force necessary to effect the transmission did not, as in land lines, depend almost entirely on the size and length of the conductor. The electrostatic capacity of the line immediately began to play an important part, and signals were found not to be so instantaneously transmitted as they were on existing lines. Again, there was no opportunity of using relays so as to effectively shorten the larger lines, and it was pointed out by Thomson that the rate of signaling would be inversely as the square of the length.

Such difficulties as these, combined with the very evident mechanical difficulties of manufacturing and submerging a cable in deep water, were, to say the least, discouraging. Experiments on short lengths in the English Channel and elsewhere proving successful, faith in the possibility of larger cables grew, and very soon, through the enterprise of a few American and English business men, an attempt was made to lay a cable across the Atlantic. The history of that undertaking and its various failures are almost common knowledge, but perseverence conquered all the difficulties, and to-day very little is thought of difficulty when a long cable is proposed.

The laying of long cables brought out the fact that, as had been anticipated, existing telegraphic apparatus was not of great enough sensibility to render rapid signaling possible. This difficulty was almost immediately met by the mirror galvanoscopic receiver of Thomson, followed some years later by his siphon recorder, which is, undoubtedly, by far, the most sensitive recording telegraph known. Improvements in methods of working cables soon followed, among which, in the early days probably the most notable, is the introduction of condensers between the ends of the cable and the earth by Varley. The duplexing of the cables has already been referred to, but it is somewhat curious to note that although the electricians interested in cable working were familiar, as early as 1856 and, perhaps, earlier, with the difficulty which had prevented success on land lines, no one seems to have thought of applying the remedy. As early as 1858 a patent was taken out by Thomson in which he proposed to overcome the difficulty of duplexing a cable by a mechanical arrangement for varying the compensating currents at the same rate that the signaling current varies. He has since said that he did not propose the use of condensers, because a means of producing a sufficiently good model cable was not then known.

The invention of the telephone constitutes one of the greatest advances that have been made in telegraphic communication. This is an acoustic telegraph which has the very important merit that the audible signals are spoken words, and hence the instruments can be used by any one who can hear and speak.

It is well known that sound is transmitted through the air from speaker to hearer by waves of condensation and rarifaction which affect the drum of the ear. Wheatstone, as early as 1831, showed that these waves could be transmitted from one place to another, at a moderate distance, through wooden rods and afterwards conveyed to the ear by the vibrations given to the air by the end of the rod. Similarly vibrations given to one diaphragm can be given to another, at a distance, by connecting the two diaphragms by means of a stretched wire or cord. To cause the vibrations of one diaphragm to produce corresponding vibrations in another diaphragm, at a distance, by means of electric currents, was the problem of the electric telephone. The first to propose this seems to have been Charles Bourseul, who, in 1854, suggested the use of two plates, one at the transmitting station, which, by the varying pressure of the air due to the sound waves, would open and close an electric circuit, while the other was to be acted on at the receiving station by an electro-magnet through which the electric currents passed. In 1861, Philip Reis, of Friedrichsdorf, proposed, in a lecture delivered before the Physical Society of Frankfort, to use an instrument which he called a telephone, for the production at a distance of music and human speech. The apparatus consisted of a stretched membrane forming one side of a box into which, by means of a mouthpiece, the sounds could be directed. This membrane was made to open and close an electric circuit at each vibration. At the receiving end an electro-magnet, consisting of a thin rod of iron surrounded by a coil, was placed. The successive interruptions and closings of this electric circuit was, in accordance with a discovery made by Dr. Page, of Salem, Mass., in 1837, to produce sounds of the same pitch as those of sound directed into the box of the transmitter. This method failed for speech, for the simple reason that speech has more characteristics than pitch and was only partially successful for musical sounds, variations of loudness and quality being wanting.

To produce not only frequency of vibration but also loudness and quality of the sounds evidently required a transmitter and receiver which did not depend for its action on simple interruption of the current, but which varied the current in a pulsating manner, similar to the variations of pressure on the diaphragm, due to the sound waves. Such an apparatus of a very perfect type was produced by Graham Bell in 1876, who, in the descriptions of his apparatus, given in his patents and elsewhere, shows that he thoroughly understood what had to be done. We all know that the instrument which he produced did it. Since the publication of Bell's invention a great many modifications have been produced; most of them, however, have been held to be similar in principle to Bell's. One field of investigation has, however, been fruitful of improvement. In the original patent of Bell, and in the *caveat* filed almost simultaneously by Gray, it is pointed out that the variations of the current may be produced by causing the vibrations of the diaphragm to vary the resistance of the circuit. This idea has proved of great value in increasing the loudness of the sounds given out by the Bell telephone used as a receiver. A great many forms of these "microphone" transmitters have been invented. Among those who have made important contributions to this subject we may mention Berliner, Edison, Gray, Hughes, Blake, Gower and Hunnings.

Another form of telephone has been proposed by Prof. Dolbear. In this telephone system one diaphragm of the receiver is made to form one plate of an electric condenser, and the varying force on this plate, due to the fluctuations of the charge, causes it to vibrate in response to the varying electro-motive force produced by the transmitter. This condenser telephone can evidently be used either as a transmitter or receiver, and, as Dolbear has pointed out, may be rendered sensitive by keeping one plate of the condenser at a high potential.

Another interesting discovery in this subject should be mentioned, namely, the transmission of speech from one place to another by variations in a beam of radiant heat or light. This is based on the discovery by May and Smith of the variation of the electric resistance of selenium when exposed to light or radiant heat. The experiments of Bell and Sumner Tainter have shown that if a beam of light be reflected from a mirror to a bar of selenium which is in the circuit of a telephone and battery, the telephone will repeat words spoken to the mirror.

PERSONAL.

Mr. A. L. Rohrer, of the Thomson-Houston Electric Company, and Miss Carrie Laura Gould were married at Lynn, Mass., April 8.

J. B. McKee, son-in-law of President Harrison, has been elected president of the Wightman Electric Manufacturing Company, of Scranton, Pa.

Mr. George H. Roe, general manager of the California Electric Light Company, San Francisco, is visiting New York, with headquarters at the Electric Club.

Mr. T. B. Doolittle, telephone pioneer, spent part of last week in Albany viewing the wreck of the telephone exchange. He also made a short stop at the Electric Club, this city.

Mr. E. R. Gilman, the enterprising head of a number of progressive electrical institutions of the West, passed through New York last week on his return from a brief visit to Boston.

Mr. Timothy W. Sprague, of the Thomson-Van Depoele Electric Mining Company, Boston, stopped for a day or two in New York, last week, on his way to the South. Mr. Sprague will make a business trip of several weeks' duration.

Mr. Nugent Robinson, chief editor of *Once a Week*, accompanied by his private secretary, has left this city for an extended trip through the West and California. During Mr. Robinson's absence, Charles T. Cunningham, the well-known art critic, will be in charge of the paper.

TELEGRAPHIC.

.... John Campbell, who has had charge of the Pittsburgh office of the Postal Telegraph Company for several years, has been promoted to the office of superintendent for Western Pennsylvania and Eastern Ohio.

.... Ten telegraph instruments have been located in the different buildings at Fort Thomas, Newport, Ky. The enlisted men are being instructed in telegraphing and military signaling under the direction of Lieutenant Dentler. Musician C. W. Alderick, of Company G, will be the telegraph operator detailed.

.... Although the Financial Telegram Company is to pay the Boston Stock Exchange $10,000 for quotations it is in reality paying but $1,000 more than the present company, which is charged no rental. In return for the $10,000 per annum, the Exchange assumes the salaries of four reporters which aggregate $2,400, and allows the ticker company to charge members $6,600 more for service. The total of these two items—$9,000—is so much saved to the ticker company and leaves a balance of but $1,000 as the net cost of their privileges.

.... Jay Gould and Postmaster-General Wanamaker had a conference in Washington last week. Telegraph tolls was the principal theme of the talk. Next June will be two years since Mr. Wanamaker fixed the schedule of rates which the government should pay the Western Union for the telegraph service. The Western Union refused to accept these rates, but continued to perform the service. The consequence is that the government has paid nothing for its use of the telegraph since that time, and the amount now due the company has reached large proportions. Mr. Gould talked the matter over with Mr. Wanamaker, but no definite conclusion was reached.

Physiological Effects of Alternating Currents.

Dr. Edward Tatum has recently completed some very remarkable experiments on the physiological effects of alternating currents. He finds that the danger of the current diminishes as the number of alternations per second is increased. Thus it took 20 times as strong a current to kill a dog when the alternations were 4,500 per second as when they were 120 per second. When the alternations were 300 per second, the current was only half as dangerous to life as when the alternations were 120.

FINANCIAL.

Closing quotations of electric stocks, from F. Z. Maguire & Co., Electrical Securities, 18 Wall street, N. Y., Saturday, April 11, 1891. New York, Boston and Washington Stock Exchanges.

NEW YORK.	
Western Union Telegraph Co.	81⅛
American Telegraph & Cable	83
Central and South American	*145
Mexican	*210
Commercial Cable Co.	105
Postal Telegraph Cable	39
Edison General Electric Co.	98
Consolidated Electric Light	
Edison Electric Illuminating Co.	78
United States Electric Light	80
North American Phonograph	
BOSTON.	
Thomson-Houston Electric Co.	46¼
" " " Preferred	25¼
" " " Series C.	9¾
" " " Series D.	7
" " International Co.	
" Welding Co.	
" European Welding Co.	
Ft. Wayne Electric Co	12¾
Westinghouse Electric Mfg. Co.	18
TELEPHONE:	
American Bell	198⅛
Erie	49⅛
New England	91
Mexican	.85
Tropical American	.85
MISCELLANEOUS:	
Edison Phonograph Doll	.50
WASHINGTON.	
Pennsylvania Telephone	25
Chesapeake and Potomac	57¼
American Graphophone	5⅛
United States Electric Light (Wash'ton)	157
Eckington and Soldiers' Home Electric Railway	55
Georgetown and Tennallytown	62

*Ex. Dividend.

* * An electric railroad is to be built from San Jose to Alum Rock, Cal., a distance of seven miles.

* * The speed of the interurban electric line, between St. Paul and Minneapolis, is to be increased to 25 miles an hour.

* * The St. Louis Cable and Western Road, St. Louis, Mo., is to discontinue the use of the cable and adopt electricity.

* * The Pittsfield, Mass., Street Railway Company has completed arrangements for an electric outfit. Work will commence immediately.

* * The works of the Electric Traction Manufacturing Company at New Orleans have been closed, and the employés, some 50 in number, discharged.

* * Clinton, Ia., is to have five miles of electric street railway, which the Thomson-Houston Company is to have equipped and in operation by July 1 of the present year.

* * Deputy Sheriff Finn last week received another attachment against the United Electric Traction Company, of 115 Broadway, for $2,029 in favor of the Butler Hard Rubber Company.

* * The Boston syndicate which purchased the Trenton, N. J., City Railway is after the horse railway company, and will spend $250,000 in improvements. Electricity and a belt line are talked of.

* * Fire broke out, April 5, in the engine room of the Eddy Electric Company's factory at Windsor, Conn. Prompt action extinguished the fire, but it looked for a time as if the valuable plant would be destroyed.

* * The directors of the Western Electric Storage Battery Company met last week, at Kansas City, Kan., for the purpose of organization. The following officers were elected: V. J. Lane, president; Thomas F. Clohesey, secretary; A. A. Lovelace, treasurer.

* * The Bristol, Va., Gas, Electric Light and Power Company has bought out the Bristol street railway systems and will supplant the horse cars with cars using electricity for motive power. Work will be commenced on the new system just as soon as the bad weather is over.

* * The new building for the Washburn & Moen Manufacturing Company, at Waukegan, Ill., will be quite extensive. The main building will be 140 feet in width by 400 feet in length, with a wing on one side 40 feet in width and 160 feet long, and one on the opposite side 40 feet in width by 100 feet long. The building will be entirely of steel, designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn.

* * The electric road now in construction for the Jamestown Street Railway Company is rapidly nearing completion. Six of the cars have arrived. They are of the vestibule pattern, handsomely finished in white and gold on the inside, and painted a blue-black on the outside. There was quite a contest over the franchise between the Citizens' Railway Company and the Jamestown Street Railway Company, the latter getting it. Construction was begun in the early part of February and has progressed rapidly ever since. The power house is a large brick structure situated on the line of the N. Y., L. E. & W., and the N. Y., P. & O. Railroads. The coal is weighed in the car before being dumped into the coal cellar. The Short Electric Railway Company, Cleveland, are constructing the road, which is to be completed by the first prox. The poles and wires have arrived for the municipal plant and the Fort Wayne people are expected every day to commence work.

Chandler's Elevated Tricycle Road.

The illustrations on this page show two views of a novel elevated electric railroad, invented by J. G. Chandler, of Racine, Wis. The car trucks bear on a single rail with two guide rails placed parallel to and two feet above the single rail. The track is supported on a single line of iron posts. The trucks are equipped with two wheels bearing on the single rail and two guide wheels bearing laterally on the inside of the guide rails. Each truck is designed to be equipped with a 30 horse-power electric motor, there being two trucks to each car. A flange on the guide rail would prevent the car leaving the track should the main wheels of the truck break or leave the single track. In case of such an accident another safety device is arranged to support the load on the trucks and grip the guide rails, acting as a brake. A 45 foot car, it is claimed, can easily take a curve of 20 feet radius.

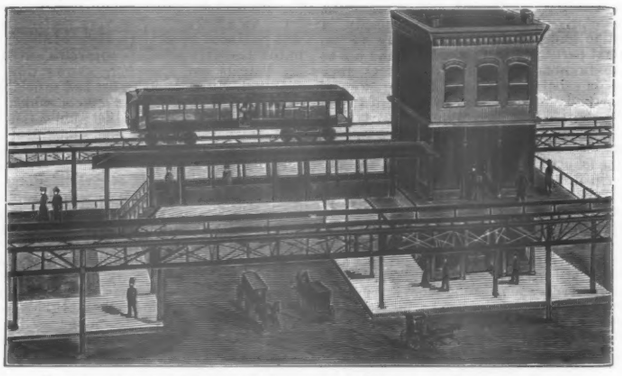


FIG. 1.—GENERAL VIEW OF CHANDLER'S ELEVATED TRICYCLE ROAD.

The Bristol Belt Line Railway Company.

The Bristol Belt Line Railway Company and the Bristol Street Car Company have been bought out by Mr. A. H. Leftwich, of Spartanburg, S. C., and Mr. W. A. Stadelman, of Philadelphia, Pa., who have already begun the work of consolidating these roads and changing them to an electric railway, under the name of the Bristol Belt Line Railway Company. Mr. S. L. Nicholson has been made superintendent of the road, and a large force of men are now at work planting the poles, laying track, etc. The road will be over eight miles long, and five cars will be put in use at once. Compound condensing engines and steel tubular boilers will be placed in a brick power house, which is now being built. A frame car house, 50x80 feet, is being erected. It is expected that the road will be in operation by the middle of June.

The Rae system will be used. Two 40 horse-power equipments, and three 30 horse-power equipments, and one 65,000 watt generator will make up the electrical equipment.

FIG. 2.—CHANDLER'S ELEVATED TRICYCLE TRACK AND TRUCK.

A Note from Mr. Olof Dahl.

TO THE EDITOR OF ELECTRICAL REVIEW:

Mr. A. T. Weston, in his letter appearing in your issue of April 4, has apparently misunderstood the writer's application and use of Mr. Weston's clutch.

The original idea was to use the clutch only as an automatic releasing device. This is possible by adjusting the springs to such a strength that when the pull and current increase to a degree that would be dangerous to the motor, the clutch will slip and the current will be checked. This will enable the use of only one motor per car, since the motor can be guaranteed against burn-outs.

Very respectfully,
OLOF DAHL.

Allegheny, Pa., April 10.

The Latest Figures.

Whipple's Reports for April, 1891, gives the following information:

CENTRAL STATION COMPANIES.

Stations in United States	1,572
" Canada	120
" Cuba	1
" Mexico	10
Total Stations	1,703

GAS COMPANIES.

Companies in United States	973
" Canada	49
" Mexico	1
Total	1,023
Companies operating Electric Lights, U. S.	279
" " " " Canada	20
" " " " Mexico	1
Total	300

STREET RAILWAY COMPANIES.

Companies in United States	917
" Canada	25
Total	942
Electric Roads in Operation and under Contract in United States	292
Electric Roads in Operation and under Contract in Canada	6
Total	298
Cable Roads in the United States	48

* * Portland and Oregon City, Ore., are to be connected by an electric railroad.

Description of the Reconstructed Factory of the Belding Motor and Manufacturing Company, Chicago.

Accepting the invitation of Mr. Dexter, general manager of the above company, your correspondent took a pleasant ride of about 20 minutes on one of the suburban trains of the Chicago, Milwaukee & St. Paul Railway, to the manufacturing town of Hermosa, Ill., where this factory is situated. A better location than that possessed by this company could not be imagined. They are the owners of a desirable 10-acre block of ground through which the trains of the Chicago, Milwaukee & St. Paul run, necessitating a switch of but a few hundred feet from the main line to the factory, which stands on the south side of the property, one block west of which the trains of the Chicago & North Western Railroad pass. On January 20 last, upon the same site, and all ready for occupancy, stood as complete a factory as could be wished for, but, alas! a little blaze was discovered when it was too late, and the building was destroyed by the flames.

No time was lost in commencing the reconstruction of the factory, and to-day it stands complete and with nearly every department in working order. The building is entirely of brick, two stories high; length, 300 feet; width, 50 and 80 feet. Power is supplied by boilers of 500 horse-power and two 125 horse-power New York Safety Steam Power Company engines. There will be employed upwards of 1,000 people. The heating of the factory is accomplished entirely by exhaust steam, and they claim to be able to raise the temperature to 65 degrees Fahrenheit in 20 minutes in zero weather. The entire atmosphere being changed every 15 minutes, this, together with 100 large windows, should make a system of ventilation impossible to improve upon. There is not a dark corner in the building, the light being perfect. Fuel light is used entirely, a tank of 285 pounds capacity being sunk in the ground about 75 feet from any portion of the building. The boiler and engine rooms are models of cleanliness. There will be installed five Edison generators, one 60 light arc machine, Brush system, and one 30 horse-power Belding generator. The office of the superintendent will be on the first floor, near the main entrance.

They will have their own brass foundry, which will be a novelty in itself. A regulation width track runs the entire length of the ground floor, with pits 4½ feet deep for working on motors under trucks. The heavy machinery is all placed on this floor, also a large freight elevator run by a 10 horse-power motor, Belding type. A fireproof vault, 25x5, has been constructed apart from the building, for safety of patterns, blue prints, etc.

The drafting rooms, armature and magnet rooms, tool room, commutator department and carpenter shops, store room and wood working machinery departments, are all on the second floor.

The systems of drainage, protection against fire, ventilation and, in fact, the whole reconstruction of the factory, has been done under the special supervision of Mr. N. S. Possons, general superintendent. Mr. Possons was born in Albany county, N. Y., received his mechanical education in New England, and filled most responsible positions with the Brush Electric Company, of Cleveland, for over 12 years. Evidences of his long experience and ability stand boldly out in the new factory of the Belding Motor and Manufacturing Company.

On the grounds of the factory a test track, with short curves and a grade of eight per cent., has been built for testing the motors, where they will be given a more severe test than they will ever get in active use.

Chicago, April 6. L. W. C.

* * Plainfield, Ind., is thoroughly awake and alive to the importance of the much talked of electric line between there and Indianapolis, and any move made by responsible parties, with a view to building such a road, will meet with a hearty response and welcome from many wealthy citizens.

* * The People's Railway Company, of Syracuse, N. Y., has made application to the common council of that city, asking permission to use electricity as a motive power for the operation of its lines, and to approve the overhead or trolley system. A similar petition was also presented from the Consolidated Street Railway Company.

A New Electric Light Switch.

The Sperry special snap switch, which we show in the accompanying illustration, is the invention of Mr. Elmer A. Sperry, the well known and progressive young electrician, of Chicago. The action of this very novel incandescent switch is unlike anything that has hitherto been made. It does away entirely with the dogs or other small parts which are so liable to derangement in small switches. The working parts consist of but

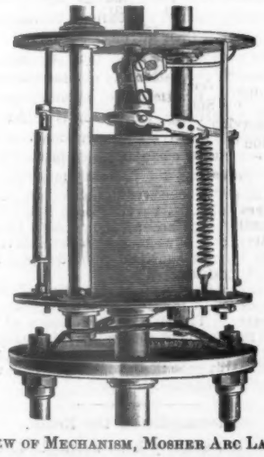
SPERRY SWITCH.

two small pieces, both of which can be easily seen in the cut, viz., the spring and lever. The ratchet, which controls the movement of the lever, forms part of the base of the switch. The double break made by this switch measures more than 1¾ inches and will break several times the voltage ordinarily used. The action of the lever upon the terminal contacts always keeps the contact surfaces clean and bright. The handle is so arranged as to unscrew when turned backwards for removing the cover, thus giving easy access to the interior. It will be noticed that in the method of making connection, the terminal is depressed below the surface at an angle so that the screw-driver can easily reach it from the top, requiring no extra perforation for the admission of the wires. The wires entering the switch are always open to inspection by simply removing the cover.

The switch is extremely neat in appearance, the base for the 10 ampere size measuring less than three inches over all, and is manufactured and sold by the Sperry Electric Mining Machine Company, of Chicago.

The Mosher Arc Lamp for Incandescent Circuits.

The accompanying illustration is an excellent representation of the perfected Mosher arc lamp. The mechanical portion is shown, omitting the wire resistance and jacket, which is placed just above the chimney of the lamp. In the construction of the Mosher arc lamp for direct incandescent circuits, the use of all clock-work and complicated mechanism is completely avoided. Therefore, many difficulties heretofore encountered in the use of other lamps by reason of surplus gearing,



VIEW OF MECHANISM, MOSHER ARC LAMP.

are effectually overcome. A solenoid, a simple clamping device, a regulating spring and a smooth carbon rod constitute its controling features. The carbons are always kept apart when the lamp is at rest by a regulating spring. When in operation the pressure of the current through the derived circuit coil forces the carbons together, and the two always reliable forces operate against each other to maintain a normal arc. The strength of the spring can be instantly increased and the arc lengthened by tightening the nut at the top of the spring. The resistance is composed of fine braided wire, enclosed in a jacket, and can be placed over the chimney or elsewhere. It can be varied in a few minutes by changing the connection. For outdoor use a weather-hood is unnecessary if the rheostat is placed in a protected position separate from the lamp. It will burn singly or in series. It can be so adjusted as to burn on any direct system of 50 to 125 volts, and on a uniform current of three to six amperes singly, and eight to ten in series, and furnish a light varying in candle-power from 1 to 2,000, according to adjustment.

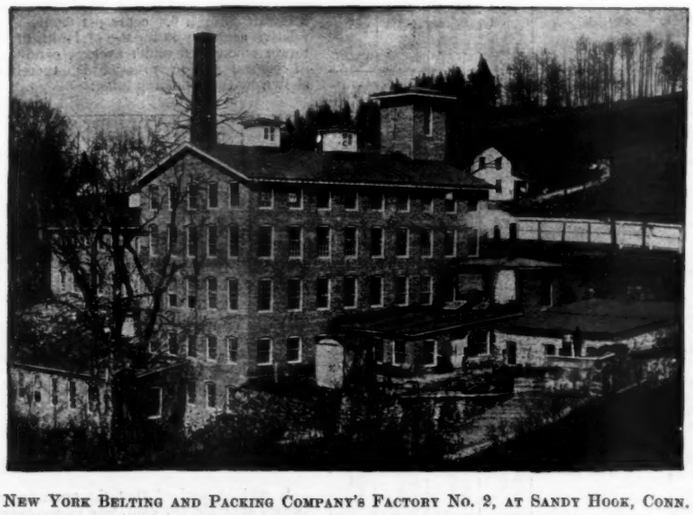
New York Belting and Packing Company.

The company named above, which has been in business over 50 years, is too well known to need any historical sketch at our hands. The offices and warerooms of the company are at 18 and 15 Park Row, New York city, while the factories are at Sandy Hook, Conn., and Passaic, N. J.

Our illustration shows factory No. 2, at Sandy Hook, Conn. The Sandy Hook property, upon which factories 1 and 2 are located, covers 135 acres. Factory No. 1 is located upon and surrounded by 100 acres of this land. The remaining 35 acres are devoted to factory No. 2. The two factories are about one-half mile apart. The company employs, in its three establishments, 600 hands, of which 350 are at work at Sandy Hook, living very comfortably in cottages adjacent to the factories, forming a thriving industrial community. Factory No. 1 consists of a main building, built of brick, 200 feet long, 70 feet wide and four stories high. From time to time shops and out-buildings have been erected and added to the factory proper. Leffel turbine water wheels, of the most improved design, furnish power for running the machinery, aggregating 450 horse-power. The water-power is derived from two dams, owned by the company. In case of inability to use this water-power, from any cause, two large improved Corliss engines, each 225 horse-power, are stationed in the engine house always ready to take its place. The water dam of No. 1 factory is 30 feet high, the whole width 160 feet, with an overthrow 130 feet wide. The main building of factory No. 2 is 200 feet long, 50 feet wide and varies in height from three to five stories. Two water wheels of 125 horse-power each furnish the necessary power for operating the machinery. A Corliss engine of 250 horse-power offers an efficient substitute in case of accident to the water wheels.

The factories are all supplied with the latest and most modern plant, and old processes that have gone out of date are either thrown out or altered so as to make them equal to the newest and best machinery of their kind. The factories are under the charge of Mr. F. Cazenove Jones, a gentlemen of great mechanical knowledge and executive ability, who is in every way well equipped for the important position he occupies. The total daily output of the company's works reaches 20,000 pounds of rubber, and frequently more. This is represented in the various vulcanized rubber goods for mechanical and household purposes made by them, some of which are machine belting, elevator belts, endless belts, railway and agricultural belts, leading hose, air-brake hose, brewers' hose, cotton hose, hard rubber suction hose, linen hose, oil hose, suction hose, steam hose, test hose, anti-shaft-rattlers, bicycle tires, billiard cushions, emery wheels, pure cord, gaskets, rings, grain drill tubes, piston packing, pure packing, steam packing, salamanda packing, pure rings, fruit jar rings, wringer rolls, rubber covered rolls for bleacheries, dye and print works, tennis soling, car and wagon springs, tubing, rubber valves of all kinds, corrugated and perforated mats and matting, rubber cement and vulcanite emery wheels.

The New York Belting and Packing Company has lately been organized into a joint stock company, a large amount of English capital being absorbed. It is proposed to erect works in England at an early date, when the large continental business which is yearly increasing, can be handled by the London house with greater profit and convenience than is now possible. The American management will continue principally in the hands of Mr. John H. Cheever, with whom Mr. J. D. Cheever and Mr. F. Cazenove Jones will co-operate. These gentlemen have great financial and business experience and have for a long time handled the affairs of the company with great skill and ability.



NEW YORK BELTING AND PACKING COMPANY'S FACTORY NO. 2, AT SANDY HOOK, CONN.

Central Electric Company's Desk Lamp.

The demand for a first rate desk lamp that will throw its light where needed and not affect the user's eyes injuriously, seems to be filled very acceptably by an article being introduced by the Central Electric Company, of Chicago, and illustrated on this page.

NEW DESK LAMP.

This lamp differs somewhat in shape from the ordinary incandescent lamp, its sides being almost straight, while the bottom, or large end, is as nearly flat as possible. These straight lines are necessary in order to obtain proper reflecting surfaces, and to prevent, as much as possible, uneven intensities of light upon the object. The inside of the butt and the outside of the globe are silvered, and the incandescent filament is actually surrounded on three sides by a mirror reflecting all of the light downward. While the lamp may be placed on a level, or a little above the level of the eye, no light strikes the eye directly from the lamp, as the silvering is covered and protected by an opaque substance. The lamp is made to fit any socket, and the new features are covered by patents.

Realism in the Audience.

Thespis—I have the shrewdest manager in New York.

Banter—In what way?

Thespis—Well, he has connected the seats with wires under the floor, and turns on a light current of electricity during the heavy parts. The audience mistakes the electricity for thrills.—*N. Y. Sun.*

ELECTRIC LIGHT NEWS

—— A receiver has been appointed for the Troy Electric Light Company, Troy, N. Y.

—— The Edison Electric Illuminating Company, of New York, has declared the twenty-fourth quarterly dividend of one per cent., payable May 18.

—— The incandescent lamp factory and manufacturing plant at Harrison, N. J., owned by the Vitrite and Luminoid Company is offered for sale.

—— A bill to allow the Great Barrington Electric Light Company and the Great Barrington Gas Company to consolidate is before the Massachusetts legislature.

—— The Waukesha, Wis., village trustees have awarded a contract to the Waukesha Electric Light Company for lighting the streets with electricity for five years.

—— After long opposition on the part of the vestry, the electric light has finally been introduced into old Trinity Church, New York. The new light was first used on Easter Sunday.

—— The Board of Trade, of Chestertown, Md., has been formed with 125 members and Wilbur Eliason president. It is proposed to introduce electric lighting and a number of other town improvements.

—— The Niagara Falls Electric Light and Power Company, of Niagara Falls, Ont., have nearly completed their buildings and will soon be supplying light to the dark places around Niagara Falls.

—— It is stated on the best authority that the report of the Thomson-Houston Electric Company, to issue within a few days, will show nearly 50 per cent. earned on the common stock.—*Boston News Bureau.*

—— Bids were opened at the treasury department, Washington, April 9 for an electric light plant for the immigrant depot on Ellis Island, N. Y., the lowest being that of the Eureka Electric Company, of New York, at $17,450,

—— The lighting of the Fourth avenue tunnel, New York, by incandescent lights was tried on an experimental scale last week. The engineers claimed that the lights interfered with the signals more than the darkness and smoke in the tunnel.

—— Mayor Grant has been notified by the United States Illuminating Company that all its poles and wires on Broadway, between Fourteenth and Houston streets, have been removed, in accordance with the orders of the Board of Electrical Control.

—— The Board of Commissioners, of Asbury Park, N. J., solicit bids for lighting the streets of Asbury Park with 75 electric lamps of 2,000 candle-power, the contract to run for a period of five years from June 15, 1891. Bids must be presented on or before April 6, at noon.

—— The annual election for officers, directors and inspectors of election of the Brooklyn Electric Light and Power Company took place at the office of the company last week, resulting as follows: Directors, Thomas Black, Stephen J. Burrows, Charles A. Smylie, Theodore Dow, Edward S. Seeley, Henry H. Downes, Adolphe E. Smylie, E. Smith Newins, Augustus P. Avery; inspectors of election, James Davey, Jerome Taylor, Walter A. Pendleton. The following are the officers: President and general manager, Charles A. Smylie; vice-president, Stephen J. Burrows; secretary, Thomas Black; treasurer, Adolphe E. Smylie.

The Highest Economy in the Use of Incandescent Lamps.

BY H. WARD LEONARD.

In operating incandescent lamps of any particular make, their average life will depend upon the incandescence at which they are operated.

The higher the incandescence of the carbon filament, the greater the amount of light which will be produced by the expenditure of a certain amount of energy, and the less the average life.

Lamps can be made by any manufacturer, which shall have, practically, any desired average life, if the efficiency be not fixed.

As we decrease the power necessary, that is, increase the efficiency, we effect a saving in the first investment and in the cost of power required to operate the lamps, but, simultaneously, we decrease the average life of the lamps, and hence increase the cost in operating due to lamp renewals.

It will, therefore, be evident that whenever the cost of power and the cost of incandescent lamps for renewals is fixed, there will be a certain definite efficiency and corresponding life, which, for any particular make of lamp, will represent the condition of highest economy in the use of the lamps.

The consumer of incandescent lamps has forcibly brought to his attention the cost of the lamps he uses for renewals, but is usually unable to determine definitely the amount and value of the power required to operate the lamps. Consequently, he is frequently led to believe that the cheapest lamp for him to use is, necessarily, that which gives the longest life. Unless the power required is the same for the different lamps, this is not true; and frequently consumers are operating at very poor economy, and yet believe they are obtaining very good results, merely because their lamp breakage is small.

Let us examine this subject briefly.

The measurement of light is rated in "candle-power," and the efficiency of production of the light is rated in "watts per candle."

The number of watts required by any lamp is the product of the volts and amperes used by the lamp.

Thus a 100 volt lamp using ½ an ampere absorbs 50 watts, and if the lamp be a 16 candle-power lamp the "watts per candle," which is the measure of its efficiency, would be $\frac{50}{16} = 3.1$ watts per candle.

Similarly, a lamp of 24 candle-power taking 110 volts and .676 amperes absorbs 75 watts, and has an efficiency, as before, of $\frac{75}{24} = 3.1$ watts per candle.

These two lamps, operated as indicated above, will have the same average life, because the incandescence of the carbon, and, therefore, the efficiency is the same in the two instances. Let us suppose this average life to be 600 hours with the efficiency mentioned, namely, 3.1 watts per candle.

Now, suppose we take the lamp designed to be operated at 3.1 watts per candle, giving 24 candle-power at 110 volts, and instead of subjecting it to 110 volts reduce the pressure to 104 volts. The reduction of pressure will cause a reduction in the current through the lamp from .676 amperes to .623 amperes; consequently, the watts absorbed by the filament will be $104 \times .623 = 65$ watts. The candle-power will be found to be 16 instead of 24, as formerly. The efficiency will be $\frac{65}{16} = 4+$ watts per candle. The average life at this efficiency will be not less than 1,500 hours.

Yet it does not follow that the most economical results will be obtained by operating the lamps at such an efficiency and life, although, at first, such might be thought to be the case.

In order to to investigate this question it becomes necessary to determine the cost of power under different conditions. Perhaps the best authority on this subject is Charles E. Emery, Ph. D., who has thoroughly investigated and reported upon this question. The following values are taken from his report:

The cost of producing one horse-power for 10 hours per day for 309 days in the year, by means of a first-class engine using 27 pounds of feed water per indicated horse-power per hour, is $52.15, where anthracite coal is $4.17 per ton, and where an engineer's wages are $2.00 per day. Of this $52.15, $24.06 is the cost of the coal, and $28.09 is that due to expenses outside of coal, such as wages, repairs, oil, waste, insurance, taxes, etc. That is, it costs $52.15 to produce $309 \times 10 = 3{,}090$ horse-power hours, hence one horse-power hour costs $\frac{52.15}{3{,}090} = 1.7$ cents.

The cost of the power for operating a 16 candle-power incandescent lamp will, of course, vary with the number operated per horse power. When the lamps have an efficiency of 3.1 watts per candle, twelve 16 candle-power lamps are operated for each horse-power in the driving belt of the dynamo.

When the lamps have an efficiency of 3.6 watts per candle, ten 16 candle-power lamps are operated per horse-power; with lamps of four watts per candle, nine 16 candle-power lamps are similarly operated per horse power, and with 2.77 watts per candle 13.4 16 candle-power lamps. Consequently the cost of the power will be as follows for operating one 16 candle-power lamp for one hour:

	For lamps of 2.77 watts per candle, *i. e.*, 13.4 lamps to H. P.	For lamps of 3.1 watts per candle, *i.e.*, 12 to H. P.	For lamps of 3.6 watts per candle, *i.e.*, 10 to H. P.	For lamps of 4 watts per candle, *i. e.*, 9 to H. P.
	Cts.	Cts.	Cts.	Cts.
Cost of power per 16 c. p. lamp hour, with power at 1.7 cents per horse-power hour	0.129	0.14	0.17	0.19

If the average life of the lamps of 3.1 watts be 600 hours, that of the 3.6 watts lamp will be about 900 hours, that of the four watts lamp 1,500 hours, and that of the 2.77 watts lamp 300 hours.

Let us assume that the initial cost of a 16 candle-power lamp is 44 cents, then the cost of renewals per lamp hour would be:

	For lamps of 2.77 watts per candle, *i. e.*, 13.4 16 c.p. lamps to H. P. and 300 hours average life.	For lamps of 3.1 watts per candle, *i.e.*, 12 to H. P. and 600 hours life.	For lamps of 3.6 watts per candle, *i.e.*, 10 to H. P. and 900 hours life.	For lamps of 4 watts per candle, *i. e.*, 9 to H. P. and 1,500 hours life.
	Cents.	Cents.	Cents.	Cents.
Cost of lamp renewals per 16 c.p. lamp hour with lamps at 44 cents each..	0.146	0.073	0.049	0.029

Hence, the combined cost of both power and lamp renewals would be as follows:

	For 16 c. p. lamps of 2.77 watts per candle and 300 hours average life.	For 16 c. p. lamps of 3.1 watts per candle and 600 hours average life.	For 16 c. p. lamps of 3.6 watts per candle and 900 hours average life.	For 16 c. p. lamps of 4 watts per candle and 1,500 hours average life.
	Cents.	Cents.	Cents.	Cents.
Power	.129	.140	.170	.190
Lamp Renewals...	.146	.073	.049	.029
Total cost per 10 c. p. lamp hour when power costs 1.7 cents per horse power hour and incandescent lamps cost 44 cents each	0.275	0.213	0.219	0.219

Thus, under the conditions given, the most economical lamps to use will be those of 3.1 watts per candle and 600 hours average life.

Now, let us suppose that the cost of power varies, as it will in different locations and under different conditions. It will be noted that of the $52.15 per year for the production of one horse power, $28.09, or 54 per cent. is independent of the cost of fuel. Let us suppose that the cost of fuel is nothing, and that the only expenses in the production of power are those due to labor, repairs, insurance, taxes, etc.

	For 16 c. p. lamps of 2.77 watts per candle and 300 hours average life.	For 16 c. p. lamps of 3.1 watts per candle and 600 hours average life.	For 16 c. p. lamps of 3.6 watts per candle and 900 hours average life.	For 16 c. p. lamps of 4 watts per candle and 1,500 hours average life.
	Cents.	Cents.	Cents.	Cents.
Power	0.0684	0.0742	0.0901	0.1007
Lamp Renewals...	0.1460	0.0730	0.0490	0.0290
Total cost per 16 c. p. lamp hour when fuel costs nothing and incandescent lamps cost 44 cents each.	0.2144	0.1472	0.1391	0.1297

It will be seen that the four watt lamp of 1,500 hours average life become the most economical to operate under such conditions.

Now, suppose the price of anthracite coal, or its equivalent, to be $2.00 per ton. We then have the following relations:

	For 16 c. p. lamps of 2.77 watts per candle and 300 hours average life.	For 16 c. p. lamps of 3.1 watts per candle and 600 hours average life.	For 16 c. p. lamps of 3.6 watts per candle and 900 hours average life.	For 16 c. p. lamps of 4 watts per candle and 1,500 hours average life.
	Cents.	Cents.	Cents.	Cents.
Power	.0691	.108	.129	.146
Lamp Renewals...	.0146	.073	.049	.029
Total cost per 16 c. p. lamp hour where anthracite coal, or its equivalent, costs $2.00 per ton, and 16 c. p. lamps cost 44 cents each	0.245	0.181	0.178	0.175

From the above figures it will be seen that the four watt lamp is the cheapest to operate under the conditions given, but the advantage is so trifling that in practice the 3.1 watt lamp would be the best to use, since the lamps fall off in candle-power somewhat in long use, and with lamps having an average life of 600 hours, the average condition of the total number of lamps on a plant would be that due to 300 hours of burning, whereas the average condition of lamps having an average life of 1,500 hours would be that due to 750 hours' use, and it is evident that it will be preferable to have lamps which have averaged 300 hours of use, rather than lamps which have averaged 750 hours of use.

It will be seen by the figures given that the life alone is a poor measure of the economy of incandescent lamp, and that in order that a four watt lamp should equal in quality a 3.1 watt lamp, its life should be 2½ times as long, and that its average condle-power in burning its 1,500 hours should equal the average candle-power of the 3.1 watts lamp in burning its 600 hours.

In all instances quoted thus far, we have assumed a cost of power based upon its production for 10 hours per day under extremely favorable conditions. In the case of incandescent lighting plants, the load changes widely, and the maximum load is on for only two or three hours. The production of power is much more expensive under such conditions than when the load is constant. Statistics from a very large number of central station incandescent lighting plants, charging an average rate of one cent per 16 candle lamp hour, show that the total cost of power for operating a 16 candle-power 3.1 watt lamp is 0.4 cents per hour. The relative economy in the use of lamps of different efficiencies under average conditions of central station practice is, therefore, shown by the following table:

	For 16 c. p. lamps of 2.77 watts per candle and 300 hours average life.	For 16 c. p. lamps of 3.1 watts per candle and 600 hours average life.	For 16 c. p. lamps of 3.6 watts per candle and 900 hours average life.	For 16 c. p. lamps of 4 watts per candle and 1,500 hours average life.
	Cents.	Cents.	Cents.	Cents.
Power	.357	.400	.464	.516
Lamp Renewals...	.146	.073	.049	.029
Total cost per 16 candle lamp hour when the power to run a 16 c. p. 3.1 watt lamp cost 0.4 cents per hour, and lamps cost 44 cents each	0.503	0.473	0.513	0.545

It will be noticed that the operating expenses are eight per cent. less in the case of a plant using 3.1 watt 600 hour lamps, than in the case of a plant using 3.6 watt 900 hour lamps. This is equivalent to an increase in the net profits of 12 per cent. in the case of an incandescent electric lighting company whose expenses are 60 per cent. of the total receipts, which is an average relation between the expenses and receipts in properly operated stations.

Attention is called to the fact that if the life of the incandescent lamp be increased, or the price of the lamp be reduced, the importance of using the high efficiency lamp, rather than the low efficiency lamp, becomes even more marked than in the present instance.

Thus, if the average life of a 16 candle-power lamp of 3.1 watts be 1,200 hours, and the cost of the lamp be 40 cents, it will be found that higher economy will result by operating the lamp at 2.77 watts per candle, which will reduce the life to 600 hours. This is shown by the following table:

	For 16 c. p. lamp of 2.77 watts per candle and 600 hours average life.	For 16 c. p. lamp of 3.1 watts per candle and 1,200 hours life.
Power	0.357 cts.	0.400 cts.
Lamp renewals	0.066 cts.	0.033 cts.
Total cost per 16 c. p. lamp hour when power for 3.1 watt lamp costs 0.4 cents per hour, and lamps cost 40 cents each	0.423 cts.	0.433 cts.

In all systems having a fairly good regulation and distribution of pressure, and where coal costs from $2 upward for the equivalent of one ton of anthracite coal, the 3.1 watt lamp is the most economical.

In alternating systems as ordinarily installed, the variation of pressure is often too great to use the 3.1 watt lamp economically, and the 3.6 watt lamp should be used. Also in cases when the cost of power is extremely low, the 3.6 watt lamp should be used. It will not be found economical to operate the best makes of lamps at more than 3.6 watts per candle under any conditions met with in practice.

The majority of 16 candle-power incandescent lamps on the market to-day require from 57 to 65 watts; that is, to have an efficiency of from 3.6 to four watts, and attention is called to the fact that in order to compare in quality with a lamp of 50 watts, with a guaranteed average life of 600 hours, there should be a guarantee of 900 hours average life for the 57 watt lamps and of 1,500 hours average life for the 65 watt lamps, and that even then the consumer will not be operating at the highest economy as shown above. Furthermore, it must be borne in mind that by the use of 3.1 watt lamps the capacity of a plant already using 3.6 watt lamps will be increased 16 per cent., and in the case of a plant using four watt lamps the capacity will be increased 30 per cent.

To express this another way, it may be said that a consumer having a plant using lamps of 3.1 watts, and changing to lamps of four watts, not only suffers the disadvantage due to the fact that he is not operating at the highest economy, but he also immediately increases his investment, interest, depreciation, etc., per unit of light obtained, to the extent of 30 per cent. and subjects his dynamo to an overload of 30 per cent. with consequent greatly increased trouble and expense due entirely to the use of the low economy lamps, but frequently attributed to a defect in the dynamo as it is there that the overload manifests itself.

Forty Years in the Field of Advertising.

The idea of conducting an advertising agency was an original conception of S. H. Parvin. The need of such an agency was shown from the fact that his business was prosperous from the beginning. Advertisers quickly recognized the value of his services in saving them the expense, time and inconvenience of negotiating with publishers, and publishers soon recognized his agency as a convenient method of securing business and looking after their interests.

The basis of success in most all lines of business is unquestionably obtained through a judicious investment of capital in newspaper advertising, and in this line Messrs. Parvin's Sons have had exceptional success in serving their customers, and placing them upon that safe plane of money making.

With a business reputation of 40 years, the firm of S. H. Parvin's Sons stands preeminently high and second to none in this country, and have gained an enviable reputation for clean methods, just dealings and upright conduct.

Many advertisers have entrusted their business with this firm uninterruptedly for 25 years. This is strong evidence of the good reputation of their advertising agency, which has become a recognized institution in Cincinnati's growth and development.—*Cincinnati Commercial Gazette.*

Thermopile on the Brain.

One can scarcely keep a straight face in reading of the chimerical devices of certain scientists for solving all problems by machinery. The scheme of a Mr. Balli for gauging mental power and qualifications by putting a thermo-electric pile under people's hats to determine the amount of heat given out during cerebral operations, has about as much sense in it as the Laputans' plans for recovering, by analysis, sunshine from cucumbers.—*Boston Transcript.*

The Effect of Invention Upon the Progress of Electrical Science.

BY PROF. CYRUS F. BRACKETT, OF PRINCETON COLLEGE, BEFORE THE INVENTORS' CONGRESS.

Electrical science really begins with the labors of Dr. Gilbert. These he published in 1600. For almost exactly 200 years investigation was confined to that domain which is still sometimes called static electricity. A new era, however, dawned in 1800, when Volta gave to the world an invention whose importance can scarcely be exaggerated, the voltaic battery.

The simplicity of the device and the wonderful effects which it could produce at once excited the most lively interest, and men of science made haste to investigate it. By means of it Carlisle and Nicholson soon succeeded in decomposing water, and Ritter had a similar success with copper sulphate. Thus commenced a long line of research in electrolysis which was pursued with great success by Davy and others, and which finally led Faraday to the grand generalization known as Faraday's laws of electrolysis.

Meantime Ritter had noticed that the two plates of the same metal which have just served to convey the current to and from a liquid while undergoing electrolytic decomposition can of themselves furnish a current, and he was thus led to the invention of the "storage battery." It was Volta, however, who gave the correct explanation of its action.

Ritter, Pfaff and others observed that the conducting wires of the battery are warmed by the passage of the current, and Curtet, on closing the circuit with a piece of charcoal, produced a brilliant light. Davy systematically investigated these heating effects of the current, employing various metals as conductors, and, finally, in 1812, on making the current pass between two pieces of charcoal he produced the well known electric arc.

Thus, in little more than a decade from the date of Volta's invention, more real progress was made than in any century previous. But the true progress of electrical science is not to be measured solely, or even mainly, by the number nor by the splendor of the physical results which attend it, but rather by the insight into the operations of nature which we gain. Viewed in this light, Volta's invention was itself the embodiment of a great advance which he had made into an entirely new region. It was not the mere outcome of happy accident, but the result of severely logical reasoning upon facts which he had observed while he was investigating the so called "animal electricity" of Galvani.

Volta's fundamental research respecting the electrical disturbances produced by contact of dissimilar substances afforded him a basis for a rational theory of the action of the battery, and this theory has had a far-reaching influence, not only upon the progress of electrical science but on physical science in general. The voltaic battery rendered possible an observation out of which grew the next great invention which we will consider. In 1820 Oersted noticed that a magnetic needle was deflected from its normal position by voltaic current which was flowing in a conductor near it. He determined the relation of the current to the deflection as respects direction, and sent a brief memoir concerning the matter to well known scientists.

Arago immediately found that iron filings were attracted by a wire conveying a voltaic current. In order to strengthen the magnetic action of the current, Schweigger invented the magnetizing helix or spiral. By means of this Arago was able to magnetize steel permanently and iron temporarily. The conception of this helix was the first act of invention which was to produce the electro-magnet. Yet it was not until 1825 that Sturgeon wound a conducting wire about a core of iron to produce the electro-magnet proper. The magnet, as it left the hand of Sturgeon, was a crude device which the genius of Henry finally perfected, between the years 1828 and 1831. Henry constructed several magnets, some of which were wound with long, thin insulated wires, while others were wound with shorter and thicker wires in parallel. These could be joined either in series or in parallel. He thus had the means of studying the effects which a given battery can produce when made to actuate magnets having different windings. He also investigated the effects which are produced by the use of batteries having different electromotive forces. He thus discovered the principles which must be observed in order to secure the best results from the electro-magnet under any given conditions. Indeed, a careful examination of Henry's work will convince one that he disclosed the same result, by the light of skillful experiment, as is set forth in Ohm's now well known formula. Moreover, he clearly perceived that the magnet, as he had perfected it, offered the solution of the problem of the telegraph, and he made proof of his provision by actually installing one.

In the hands of Ampere the conducting helix was made, under one form or another, a means of investigation, which he pushed with wonderful energy and skill until he unfolded the laws of interaction between magnets and electrical currents as well as those which govern the mutual actions of the currents themselves. In short, it may be said that, as the result of his inquiries, Ampere was brought to a comprehensive theory of magnetic action which was startling alike for its simplicity and its boldness. It deserves to rank with Newton's theory of universal attraction.

The skillful labors of Faraday and Henry brought to light, by the same means, the laws of induced currents and so supplied the elements which practical inventors have since combined so as to do our bidding, whether it be to illumine our streets and dwellings, push our cars or delve in the mountain for hid treasure.

The electro-magnetic phenomena educed by the voltaic current as it flows through a helix constitutes the basis of a most admirable system of measurement for electrical quantities, while the helix itself contains in germ the whole family of measuring instruments by means of which such measurements are made. Moveover, these phenomena led the sagacious mind of Faraday to a wholly new way of regarding electrical action in general. He clearly perceived that the old doctrine of the "imponderables" was untenable and he looked for some common nexus between all physical actions. He was disposed to refer the interactions which bodies exhibit in consequence of their electrical states to the medium intervening between them. As light is believed to be transmitted by a universal medium, he sought to find, by experiment, some connection between light and electro-magnetic action. On passing a beam of plane polarized light through a block of glass, within a magnetizing helix, he found that the beam was twisted when the current was made to flow through the helix.

Maxwell undertook the very important work of subjecting the results reached by previous workers, and generally set forth in Faraday's "Experimental Researches," to mathematical discussion which must be considered the final test of truth. Not to mention others, one very important result was his electro-magnetic theory of light. But experiments were wanting, save the single one of Faraday, just mentioned, to confirm his deduction. It was reserved for Hertz to supply the necessary evidence in support of Maxwell's theory, which he had lately done by making skillful use of the oscillating discharge of charged conductors, earlier demonstrated by Henry.

Thus it appears that the two great germinal inventions which have most influenced the progress of electrical science during our century are the voltaic battery and the magnetizing helix. The one gave us first the means of evoking electrical energy continuously, while the other gave us the means of applying it as we might have occasion. Both contributed powerfully in a direct way to the progress of electrical science by reason of the various and startling phenomena which they revealed.

But it seldom happens that progress continues long in any department of physical science unaffected by the practical application of its results in the arts, and, conversely, such applications almost invariably react to stimulate scientific inquiry. Two principal reasons for this effect may be noticed. When the apparatus and the operations of the laboratory give place to those which are suited to commercial uses, new conditions arise which frequently bring into prominence phenomena before unobserved or inconspicuous. These then become subjects for new investigations and, in due time, scientific progress is the result. Thus telegraphy brought its knotty problems as well as its successes, especially when its lines were stretched under the sea and when one wire was required to do the duty of several, and nothing less than the highest skill and the most severe analysis has sufficed to effect their solution. So, too, telephony was early beset with peculiar difficulties, notwithstanding the simplicity of the means which it employs—thanks to the genius of Professor Bell—but they were such as electrical science has profited from. Speaking generally, it may be said that almost every one of the devices which are in daily use for the transformation of mechanical work into electrical energy, and the converse, has compelled its inventors, in the course of its evolution, to contribute something to the common stock of scientific truth.

It was regretted by Franklin that the results of electrical research had not been turned more to the use of man in practical affairs. Faraday did not doubt that the time would come when that reproach would be removed, but he felt it a duty on his own part to push on the work of discovery, and to leave industrial inventions to others. Such applications are now everywhere about us and are rapidly extending. Of course, they involve the investment of millions of capital, and this renders it impossible that the great public shall be indifferent to the science upon which they depend. Hence it is that all our schools of technology and most of our colleges have already made provision for training in it.

Every consideration leads us to expect that future progress in electrical science will be more rapid than it has ever been in the past; the present offers to the student the accumulated treasures of knowledge and the hope of scientific distinction as well as that of pecuniary reward. It can hardly be that among the scores of young men to whom these advantages come as inspirations, there will not be found some who shall prove to be worthy successors of the great men into whose labors they so easily enter.

International Protection of Industrial Property.

BY COL. F. A. SEELY, BEFORE THE INVENTORS' CONGRESS, WASHINGTON, D. C.

The difficulty in securing international protection for inventions exists by reason of systems of law in many countries under which an alien inventor is debarred from protection by reason of having first complied with the law in his own country. Much thought has been expended upon the removal of this difficulty, but the true and universal solution has been missed in Europe by the failure to take cognizance of radical differences in patent laws. Since in most countries the publications of a description of an invention constitutes a bar to the grant of a patent or vitiates one if subsequently obtained, it would seem that the difficulty would vanish if the nations of the world were to agree that such publication, when official and in connection with the grant of a patent in any country, should not affect the inventor's right in any other.

The International Convention of Paris in 1883, while wisely planned in many respects, fails of its purpose when considered from an American aspect, because it failed to take note of special features of American patent law.

It established what is called a period of priority, "running from the deposit of the application for patent, during which the inventor might file his application in the other countries accepting the convention, without having his rights affected by anything occurring in the interval, including publication or the grant of the patent to a third party." This works very well in countries where there is no examination into novelty, and where the publication follows the deposit after only a short interval. It does not work in the United States because in most cases the whole period of priority expires before the grant of the patent in this country, and the inventor rarely is willing to take out patents abroad till he has secured them at home. If the period of priority had at first been adjusted so as to run from the publication rather than from the deposit, it might have been satisfactory to the other countries, and at the same time advantageous to the American inventor. This was the proposition of the United States that was voted down in the Madrid Conference in 1890.

The scheme proposed by the Pan-American Congress took no note whatever of the United States patent law. It was based on the laws of the majority of the South American States, which differ widely from ours, and the principal features of the scheme are wholly incompatible with our system.

Absolute reciprocity exists between this country and Canada, and the laws of Venezuela and Hawaii resemble ours in so many particulars that it may be said to exist with them also. By an amendment recently proposed to the German law to go into effect October 1st, that Empire practically accepts the American proposition which was refused at Madrid.

Our law fully recognizes the international principle; it is more liberal than any proposed terms of reciprocity. In fact, its very liberality constitutes a bar to agreements with other nations, because we have no concessions to make in return for those we demand. The wisest and most hopeful course for us appears to be to take note of the concessions mutually made by other nations for the benefit of their own people, and to secure to our own people the benefit of these concessions, which, by our liberal legislation, we are prepared to do.

VIEWS, NEWS AND INTERVIEWS.

Stray dogs in Minneapolis don't worry the people much, and the city doesn't need to support a dog pound. You furnish the dog and the electric cars do the rest. During February they killed 64 dogs, and one morning recently the bodies of 13 canines were found along the tracks. It keeps the health department busy.

"Uncle Billy," of Titicut, Mass., says he hopes the selectmen will have them 'lectric light wires put up high, or else some of the boys will get hold on 'em some night and try to shut off the light, just fer fun. Then they will be apt to have sore fingers and can't do the milkin'.

In view of the 7 to 4 report of the Massachusetts House committee on manufactures against municipal ownership of gas and electric light plants, the friends of the Nationalist idea are beginning to think that no particular good was done to their cause by the recent trip to Richmond, Va.

Regarding the placing of the preferred stock of the Westinghouse Company, Mr. Westinghouse stated to a reporter that "the negotiations had progressed satisfactorily, and a favorable conclusion should be reached in a very few days." And now a rumor comes up from Wall street that a number of New York hardware merchants are financially interested in the reorganization.

Mr. Geo. H. Roe, general manager of the California Electric Light Company, San Francisco: "Yes, I have received several shocks from arc currents. How does it feel? Just like a strong man had struck you a powerful blow on the chest with a sledge-hammer. Seems to knock the wind out of you. There is none of that tingling sensation peculiar to milder currents—only the one tremendous feeling of a blow and then you find yourself lying down. The tendency of an arc current to knock a man down is fortunate, as it nearly always breaks his hold on whatever is shocking him and prevents a repetition of the shock. When you get up, your knees tremble and you feel pretty generally unstrung.

"In San Francisco, not long ago, a lineman was on top of a 60 foot pole trimming an arc lamp. He received a shock and was knocked off the pole, falling feet downward. His trousers caught on one of the iron steps on the pole, were ripped up to his waist and he was turned over, continuing his fall head first. Just as the spectators were expecting to see his brains dashed out on the sidewalk, his leather belt caught on another step and he hung dangling in the air about 25 feet from the ground. A rope was procured, and he was rescued and put to bed. After he got over his scare, he was as good as new."

H. H. George, who walks the Watertown track every morning from here to Watertown, reports 11 telegraph poles down beside the track.—*Waterbury, Conn., American.*

Isn't the railroad track usually down, Mr. George?

Foreign powers are about to adopt the electrical welding method for making shells for artillery. How would it do to use the electric process to cement an agreement of peace between the monarchies?

"I am a mechanician, not an electrician," asserts Thomas A. Edison, "and I have no wish to claim the credit due to the gentlemen associated with me. I am an inventor, not an electrician."

The Pennock system of electric light will continue on exhibition on Tuesday, Wednesday, Thursday and Friday evenings, at the residence of John D. Van Nuys, 712 Hamilton street.—*Peoria, Ill., Herald.*

The man who makes electric light from teacups has evidently moved from Chicago to Peoria. Wonder why?

KINDRED INTERESTS

George Cutter, 333 The Rookery, Chicago, has issued a very artistic and brilliantly written circular telling about Simplex wire.

The Illinois Electric Material Company have been appointed western agents for the Russell Electric Company, of Boston, to introduce the latter company's new arc lamp for arc and incandescent circuits.

The Partrick & Carter Company, 125 South Second street, Philadelphia, have issued a new catalogue of their large stock of electrical supplies. The electric needle annunciators, for which this company owns patents, receive prominent notice. A large line of electrical house furnishing specialties is illustrated and priced.

The Electrical Supply Company, of Chicago, predicts that line construction this season will be of a higher order than before. One indication of this is the call for high insulation brackets which are now deemed essential to first-class work. The Electrical Supply Company's line of these brackets embraces some 20 different forms, of new design. The insulator screws are slit so that the expansion of the metal cannot break the glasses.

The Central Electric Company, Chicago, have recently arranged with the Bryant Company to handle their sockets and switches and already report large sales. They carry a complete stock of all sizes and capacities. As the sole western agents for the Paiste Edison key sockets the Central Electric Company have already had numerous large orders for this latest improved socket, which is virtually a five ampere Paiste switch, mounted in a handsomely finished shell.

The Eureka Tempered Copper Company, North East, Pa., have received this letter:

WATERTOWN, N.Y., Dec. 26, 1890.
EUREKA TEMPERED COPPER CO.,
North East, Pa.

Gentlemen: Please refer to your letter of the 29th September, 1890, addressed to Thos. Ramsdill & Co., Albany, and then let us know what the material was of which the box you sent them was made.

We have just taken an order from them for an engine and they insist upon having some of the boxes made of this same metal. If you will let us know what it was and give us your price to us, we will send you pattern. Yours truly,
WATERTOWN STEAM ENGINE CO.

Address, for Circular of Styles and Prices,
JARVIS B. EDSON,
87 LIBERTY STREET, NEW YORK.

PAISTE CHINA SWITCHES.
5 and 10 Ampere Capacity.
FOR FINE RESIDENCE INSTALLATIONS.
IVORY TINTED, TERRA-COTTA TINTED,
BLUE TINTED, GREY TINTED,
YELLOW TINTED, PINK TINTED.
BRIGHT GOLD FINISHED,
DULL GOLD FINISHED,
JET BLACK FINISHED.
Cheap, Handsome, Durable. 5,000 in stock.
ASK YOUR SUPPLY MAN FOR THEM.

H. T. PAISTE,
1201 MARKET STREET, PHILADELPHIA, PA.

A New Dry Battery—The "Gladiator."

A new primary battery is being introduced by the North American Electric Company, of Chicago. We are informed that the battery has stood some very exhaustive tests, and shows the extremely high voltage of 2.5 efficiency and has a wonderful recuperative power and an extremely low resistance and long life. This battery is designed for all kinds of bell work as well as telegraph use. The North American Electric Company is making rapid strides in battery business, and before long will enter the field in another line and expect to combat the most prominent batteries in the market. Their announcement appears in this issue of the REVIEW.

WANTED salesmen who are now selling goods to Telegraph and Telephone Companies to take, as a side line, a new tool for handling poles. Sells readily, good profits. Apply, with reference,
KEYSTONE MANUFACTURING & SUPPLY CO.,
Allegheny, Pa.

IF YOU have anything pertaining to electric machinery you want to sell, send us the description.
IF YOU want anything pertaining to electric machinery, send us your inquiries.
FRANK RIDLON & CO.,
Dealers in New and Second-Hand
Electric Light & Power Machinery,
196 SUMMER STREET, BOSTON.

THE REMINGTON STANDARD TYPEWRITER

Presents the practical results achieved by the best inventive and mechanical skill, aided by capital and the experience gained during the FIFTEEN YEARS in which it has been the
STANDARD WRITING-MACHINE OF THE WORLD!
Send for Illustrated Catalogue.
Wyckoff, Seamans & Benedict,
327 BROADWAY, N. Y.

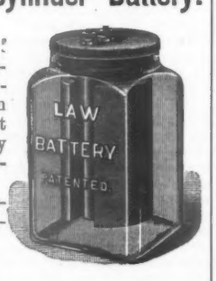
WANTED.—Price Lists of Dynamos and other electric apparatus, in order to procure an agency.
OLIVER ZELAND,
STOCKHOLM, SWEDEN.

MADE BY
Chas. A. Schieren & Co.,
New York, Chicago, Boston, Philadelphia.

72-Inch Double Belt (Second Order) for LOUISIANA ELECTRIC LIGHT CO., NEW ORLEANS, LA.
Two 48-Inch Double Belts for LOUISIANA ELECTRIC LIGHT CO., NEW ORLEANS, LA.
One 54-Inch Three-Ply Perforated Electric Belt for TACOMA RAILWAY & MOTOR CO., TACOMA, WASH.
One 41-Inch Three-Ply Electric Belt for CITIZENS' ELECTRIC ILLUMINATING CO., BROOKLYN, N. Y.
Two 30-Inch Three-Ply Perforated Electric Belts for GAUTIER STEEL DEPT., JOHNSTOWN, PA.

THE LAW
Double Cylinder Battery.

Surface of negative element and quantity of solution double that found in any other open circuit cell.
Weigh carefully these advantages.



Its sale has steadily increased for ten years.
LAW TELEPHONE CO.,
Sole Makers,
87 JOHN STREET, NEW YORK.

ELECTRIX SWITCH.

ELECTRIX SPECIALTIES.
Endorsed the World over by Users.
Simple. Reliable. Indestructible.
DEALERS REPORT QUICK SALES.
CORRESPONDENCE INVITED.
THE STAR ELECTRIX CO.,
1320 Wallace St., Philadelphia, Pa.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON MARCH 24, 1891.

448,936 Electrolyte for galvanic batteries; John J. Collins, Washington, D. C.

448,953 Electric belt; Willie G. Fuller, Kirwin, Kansas.

448,956 Electric insulator; George H. Graham, Ridgeland, and Thos. Gannane, Chicago, Ill.

448,960 Electrical protecter; Isaac N. Miller, Cincinnati, O.

448,998 Independent electric clock. 448,999 Secondary electric clock; William S. Scales, Everett, assignor of two-thirds to Joseph H. Clark, Quincy, and John B. Humphrey, Boston, Mass.

449 035 449,036 Electrical heater; John V. Capek, New York, N. Y., assignor of one-half to Edw. H. Johnson, same place.

449,044 Electric lighting system; Edw. H. Johnson, New York, N. Y., assignor to the Edison General Electric Co., same place.

449,081 Electric time stamp; Warren B. Martindale, Kenosha, Wis., and Ernest R. Malmborg, St. Louis, Mo., assignors, by direct and mesne assignments, to the Electric Date and Time Stamp Co. of Illinois.

449,090 Electric rock drill; William M. Schlesinger, Philadelphia, Pa., assignor to Chas. F. Van Horn, same place.

ISSUED APRIL 7.

449,655 Telegraphy; Frank Anderson, Peekskill, N. Y.; Annie L. Anderson, Gilbert H. Anderson and Homer Anderson, administrators of said Frank Anderson, deceased.

449,660 Automatic switch for electric motors. 449,661 Electrical hoisting machine. 449,662 System of operating electric elevators with landing-switches only; William Baxter, Jr., Baltimore county, assignor to the Baxter Electric Manufacturing and Motor Co., Baltimore, Md.

449,672 Train signal; Hugh J. Finn and John A. Garner, Kansas City, Mo.

449,679 Multiplex telephony; Wm. W. Jacques, Newton, assignor to the American Bell Telephone Co., Boston, Mass.

449 685 Electrical switchboard; John B. Lyon, Brooklyn, N. Y.

449,688 Speed regulator; Alfred B. Morse, Easton, Mass.

449,690 Non-interference electrical signaling apparatus; Abraham Newman, Brooklyn, N. Y.

449,709 Propelling mechanism for electric motor cars; Sidney H Short, Cleveland, O., assignor to the Short Electric Railway Co., same place.

449,715 Electric arc lamp; Elihu Thomson and Edwin W. Rice, Jr., Lynn, Mass.

449,719 Electric search-light; Barton B. Ward, New York, N. Y.

449,721 Electric connector; Geo. K. Wheeler, Chicago, Ill., assignor to the Thomson-Houston Electric Co. of Connecticut.

449,731 Automatic electric block system; Joseph A. Carlton and Henry L. Johnston, Atlanta, Ga.

449,752 Electric motor car; Harold P. Brown, New York, N. Y.

449,753 Pole for overhead systems of electric railways; John N. Brownlee, Detroit, Mich.

449,759 Time stamp actuated by electro-magnets; Warren B. Martindale, Kenosha, Wis.

449,766 Ammeter or voltmeter; Harold C. Shubert, Chicago, Ill., assignor of one-third to Warren B Martindale, Kenosha, Wis.

449,767 Cut-out. 449,921 Electric cut-out; Alfred T. Tregurtha, Everett, assignor of one-half to Henry A. Clark, Boston, Mass.

449,774 Commutator for electric motors; Henry Duenner, Boston, Mass., assignor of one-half to Frederick Bleiler, same place.

449,780 Circuit breaker for incandescent electric light systems; Friedrich Muller and James G. Greene, Elizabeth, N. J.

449,792 Electric railway; Edward M. Bentley, New York, N. Y.

449,797 Electric railway; Rudolph M. Hunter, Philadelphia, Pa., assignor, by mesne assignments, to the Thomson-Houston Electric Co., Boston, Mass.

449,829 Auxiliary fire alarm and extinguisher system; Eason L. Slocum, Pawtucket, R. I.

449,833 Bell; Arthur F. Stanley, New York, N.Y.

449,836 Method of electric welding; Elihu Thomson, Swampscott, Mass., assignor to the Thomson Electric Welding Co. of Maine.

449,843 Electric car stopping device; George W. Blanchard, Waterville, Me., assignor of one-half to Sophia G. Webber, same place.

449,847 Electrical dental engine; Frank F. Eggers, San Francisco, Cal.

449,886 Trolley support for electric cars; Frank Robinson and Percy W. J. Lauder, Bangor, Me.

449,889 Electric valve controller; Geo. E. Turner, Marion, O.

449,897 Telegraphy; Robt. G. Brown, Brooklyn, assignor to the Standard Multiplex Telegraph Co., New York, N. Y.

449,902 Support for electric lamps. 449,908 Lightning arrester; James W. Easton, New York, N. Y., assignor to P. Minturn Smith, Plainfield, N. J., and William D. Perry, Brooklyn, N. Y.

449,925 Electrical typewriting machine; Edw. F. Youngs, West Camp, N. Y.

449,977 Supporting post for electric conductors; William A. Stern, Allegheny, assignor of one-half to E. H. Silverman, Pittsburgh, Pa.

449,990 Automatic railway signal; Calvin W. Wilhelm, Mauch Chunk, Pa.

450,000 Electric lamp for street lighting; Hiram H. Carpenter, Chicago, Ill.

450,068 Electrical lock; Heinrich Grefen, Oberhausen, Germany.

450,074 Electric railway; Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Co. of Connecticut.

450,101 Cut-out; Jacob S. Gibbs, Hartford, Conn., assignor to the Perkins Electric Switch Manufacturing Co., same place.

450,103 Electrolytic apparatus. 450,104 Electrolytic cell. 450,105 Carbon electrode for electric batteries; Ernest A. Le Sueur, Ottawa, Canada, assignor of one-half to Chas. N. Waite, Newton, Mass.